

## STUDIES ON AUSTRALIAN ERYTHRAEIDAE (ACARINA).

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(Twenty-four Text-figures.)

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### INTRODUCTION.

In 1934 Womersley reviewed the Australian Erythraeidae, describing a number of new adult and larval species, and incorporating the previous work of Rainbow (1906) and Hirst (1926, 1928). He published a further paper in 1936. Since then the Smarididae have been dealt with separately by Womersley and Southcott (1941) and Southcott (1946), and the only paper published on Erythraeidae proper since the two by Womersley has been a short one by Gunther (1941) on a new species of *Balaustium* from New Guinea.

The larvae described by Womersley in 1934 were classified as: *Erythraeus* (3 spp.), *Leptus* (2 spp.), *Hauptmannia* (2 spp.), *Balaustium* (*sic*) *cristatum* and *Bochartia* (*sic*) *? longipes*, all of these being new. They were allotted to these genera following Oudemans' (1912) tentative classification of the larval Erythraeidae. It is now apparently well recognized in Europe that *Bochartia* Oudemans 1910 (with *B. kuyperi* Ouds. 1910 as genotype) is the larva of *Erythraeus* Latreille 1806 (*s.l.*) (see Vitzthum, 1925; Oudemans, 1937, following André, 1929, and Pussard and André, 1929). Womersley's *Bochartia* *? longipes* (corrected to *Bochartia* in 1936) was doubtfully allotted by him to Oudemans' genus. The author has been able to confirm the European correlation of the adult *Erythraeus* with the larval *Bochartia* by (1) proving that *B. longipes* is the larva of *Erythraeus urrbrae* Wom. 1934 (which has page and absolute priority, an *Erythraeus longipes* having previously been described), by the rearing of the larvae, taken parasitic in the field, to the adult, on two occasions, and by a number of lesser rearings; (2) the rearing of larvae from eggs laid by the adults of *Erythraeus reginae* (Hirst 1928) and *E. pilosus* (Hirst 1928) in captivity; (3) the rearing of larvae of *E. reginae*, hatching out from eggs taken in the field, to the nymph (and on one occasion to the adult); (4) rearing a larva of *E. pilosus*, taken parasitic in the field, to a nymph; (5) the rearing of the larva *Erythraeus osmondensis*, n. sp., taken parasitic in the field, to a nymph.

The rearings of the adults (*E. reginae* and *E. urrbrae*) from the larvae are the first ever achieved experimentally in this family.

In 1936 Womersley erected *Bochartia oudemansi* for another new larval species from South Australia. This species comes closer to Oudemans' definition of *Bochartia*. It is in all probability the larva of *Erythraeus imperator* (Hirst 1928), which species Womersley synonymized with *Erythraeus celeripes* (Rainbow 1906), although actually these are two quite distinct species (see further in text).

The discovery of a good deal of new material has necessitated the erecting of three new adult genera for Erythraeidae with 2 eyes on each side, i.e., related to *Erythraeus* Latr. 1806. These are: *Erythrellus*, n. gen., for an aberrant form in which the dorsal setae are modified to an imbricate scaling, with only one species, *Erythrellus imbricatus*, n. gen., n. sp.; *Parerythraeus grégoryi*, n. gen., n. sp., in which there is a row of stout spines along the ventral side of the palp distally and with some of the leg setae modified (one species only); *Erythroides*, n. gen., for forms with some highly modified setae on the legs, related to the last genus, with four species (*Erythraeus serratus* Wom. 1934 the genotype; the other three species are new). The separation of these genera from *Erythraeus s. str.* has been confirmed by the discovery of the larva of *Erythroides*, n. gen.,

which is very distinct from the here recorded larvae of *Erythraeus*. So far these new genera are known only from Australia.

The larval genus *Erythraeus* Oudemans 1912 was a completely incorrect correlation. The definition included "one eye on each side". It is a heterogeneous collection of larvae. In 1936 Womersley erected *Callidosoma* as new for his *Caeculisoma ripicola* Wom. 1934 (adult). A further species of adult *Callidosoma*—*C. womersleyi*, n. sp.—is described in this paper, and has been correlated with its larva by experimental rearings. This larva comes within the definition of *Erythraeus* Oudemans 1912 (*s.l.*), providing further evidence of Oudemans' errors in correlation.

The larval genus *Leptus* Latr. 1796 has previously been correctly correlated with its adult. A confirmation of this has been obtained by the rearing of a larva, from South Australia, to a nymph (not described in this paper).

The larval genus *Hauptmannia* is not considered here, the author having suggested (1946) that it should be referred to the family Smarididae.

Womersley's larval *Balaustium* (*sic*) *cristatum* was referred to that genus following Oudemans' classification. It has been possible to prove that this species is actually a larva of the adult genus *Microsmaris* Hirst 1926. It is quite possible, however, that Oudemans' correlation of his larvae with the adult genus *Balaustium* von Heyden 1826 was correct; *Balaustium* and *Microsmaris* appear to be fairly closely related, and *Microsmaris* has so far been recorded from only Australia and New Zealand.

Much of the work recorded here was done with material from Glen Osmond, near Adelaide, in the Mt. Lofty Ranges, South Australia. Two situations there (and many others to a lesser degree) have been examined frequently from 1936 to 1940, on an average weekly, during that time (and also to a less extent earlier and later). One of these two situations, the richer in species, was a sheltered paddock containing a large red-gum (*Eucalyptus rostrata*) and some red-gum saplings. The predominant winter vegetation here was a heavy growth of *Oxalis cernua* (Soursob), this being replaced toward the summer by *Echium plantagineum* (Salvation Jane) and *Avena fatua* (wild-oat), these being the dominant species (various other herbs are also present). Here the adults of *Erythraeus reginae*, *Erythraeus guttatus*, n. sp., *Erythraeus urbrae*, *Erythroides serratus*, *Erythroides neoserratus*, n. sp., *Leptus* spp., *Microsmaris* sp. (spp.?), etc., occur in the summer, their larvae occurring from up to a few months before (some larvae being tentative); *Erythraeus imperator* adult is found in July–December, with its probable larva, *Erythraeus oudemansi*, occurring in March–May.

The second situation was an exposed hillside, with a row of sugar-gums (*Eucalyptus cladocalyx*) running across its foot. Here there was only slight ground vegetation, both in winter and summer, and a smaller amount of leaf and bark debris around the bases of the trees. From this situation *Erythraeus imperator* and *Erythraeus oudemansi* were absent; and the adults *Erythraeus reginae*, *Erythraeus urbrae*, *Erythroides serratus* and *Erythroides neoserratus*, n. sp. occurred in smaller numbers. *Microsmaris*, both adult and larval, was quite common. Here also *Erythrellus imbricatus*, n. gen., n. sp., was found; it has not been found in other situations.

#### BIOLOGY.

The larvae of the Erythraeidae are parasitic on insects and arachnids; unlike the related Trombidiidae, none are known to attack vertebrates (some Trombidiidae parasitize insects, however). These complete rearings and partial rearings listed above enable the life-history of the Erythraeidae to be defined:

Eggs are laid by the adult females, and hatch to six-legged larvae in from 5–11 months. The larvae run about actively in grass, up tree trunks and in foliage, and will live up to 3 weeks without food. They find a suitable insect or arachnid host (most species show marked preferences), attach by their mouth-parts, and immediately extend their legs straight backwards alongside the body (presumably to raise the body fluid pressure and thus aid in the insertion of the chelicerae). After from a few minutes to half an hour, the legs relax, and now become flexed around the posterior pole of the animal, and remain thus, taking no part in the attachment (this position of the legs renders the larvae, which are frequently on exposed positions of the host, less likely

to be dislodged by being knocked against vegetation, etc.). After some days of feeding the larva is fully-fed, having increased considerably in size, e.g., from  $350\mu$  body length to  $900\mu$ ; under experimental conditions, if the larva is dislodged before it is fully-fed, it will generally re-attach itself to a fresh host (though it may now be less active). After becoming fully-fed it drops off the host. If the host is killed the larva frequently does not detach itself; particularly is this so with the thicker-skinned insects and arachnids, and experimentally it is necessary, in order to ensure its survival, unless it is fully-fed and has thus stopped sucking the fluids of the host, to detach the larva with a brush before the putrefaction of the host. After dropping off the host, the larva may wander around the tube for several days, eventually becoming immobile. After a day or more in this state the red coloration leaves the legs, and the skin splits transversely around the body, just behind the scutum dorsally, and between coxae II and III ventrally, revealing a hairy post-larval pupa (pupa I). The two pieces of the larval skin remain attached to the anterior and posterior poles of the pupa. The anterior piece comprises the larval capitulum, dorsal scutum and legs I and II, and is generally fairly firmly attached; the posterior piece consists of the skin of the dorsum behind the scutum (with the eyes in the genus *Callidosoma* at least) and the skin of the posterior pole of the larva, including legs III, and is usually loosely attached. The pupa I stage lasts 9–16 days; then the nymph emerges. This has an anus, but the genitalia are immature (the larva has neither genitalia nor anus). The nymph feeds on small insects for several weeks, the nymphal stage lasting (experimentally) 21–39 days. The nymph becomes immobile over the last few days, the skin then splits transversely, revealing pupa II. This stage lasts 15–16 days, and then the adult male or female emerges.

#### EXPERIMENTAL METHODS.

Despite the complexity of the life-history, it has been possible to rear several species of *Erythraeus* to nymphs, and two species on to adults; rearings of *Erythroides*, *Leptus* (not described in this paper), *Callidosoma* and *Microsmaris* have been achieved with larvae taken free or parasitic in the field; or, in the case of *Erythraeus* only, with larvae hatching from eggs taken in the field some months before hatching.

Many adult Erythraeidae, e.g., *Erythraeus*, *Erythroides*, *Balaustium* and *Microsmaris* will lay eggs in captivity, but so far only the larvae of *Erythraeus reginae* (Hirst 1928) and *Erythraeus pilosus* (Hirst 1928) have hatched out from eggs thus obtained. Two quite common larvae at Glen Osmond, South Australia, and elsewhere—*Erythraeus oudemansi* (Wom. 1936) and *Microsmaris* sp.—have never been observed parasitic on insects in the field by the author, nor has any insect offered ever been parasitized, and attempts at rearing these through to nymphs necessitate the selection of the largest specimens in the field; by this means a nymph was obtained from a larval *Microsmaris* (thus showing that Womersley's *Belaustium cristatum* (larval) belongs to *Microsmaris*); attempts at rearing *E. oudemansi* to the nymphal stage have not been successful, as it has not been possible to obtain an engorged larva of this species since the adoption of the above-mentioned methods.

The nymphs obtained from larvae or eggs taken in the field are not sufficient for correlations with adults from the same situation in all cases, although this can sometimes be done. They can always be used, however, for the correlation of previously uncorrelated adult and larval genera; the nymphs of *Erythraeus osmondensis*, n. sp. (larval), *Erythroides clavatus*, n. sp. (larval), and *Microsmaris* obtained from these sources enabled these larvae to be correlated correctly with their adult genera. Pupae are occasionally taken in the field, in soil and leaf débris, sometimes with the skins of the preceding stage attached (and with pupae I can then be used in the correlation of larvae with nymphs and therefore possibly with adults).

Since this work was started in 1936, various species of insects have been used as hosts, e.g., jassids (Homoptera) from eucalypt foliage, Psocoptera, etc. It has been found that, with the majority of the larvae of *Erythraeus* at least, as good or better results can be obtained by keeping them in tubes with adults (and sometimes nymphs) of a common small yellow jassid as host; these jassids can be obtained in large numbers by sweeping a couch-grass (*Cynodon dactylon*) lawn in Adelaide, during the summer

months, when the majority of the larval erythraeids occur. These hosts live for several days, and are removed as soon as they are dead, and fresh ones introduced; the larvae re-attach (it may be necessary to help them on with a fine brush). These jassids are also used to feed the nymphs and adults (some are given squashed, to make the body fluids more accessible). The jassids live longest when a small piece of fresh green grass, about 1 cm. long, is put in the tube, on which they feed and rest. The humidity within the tube is controlled by placing droplets of water on the inside of the cork. Some species, however, show marked host preferences in the field at least, e.g., for thrips, or Psocoptera, e.g., *Troctes divinatorius* L., and various insects and arachnids (e.g., chelifers) may have to be tried. The corks of the tubes must be well-fitting and free from cracks, and the author makes it a practice to slice them cleanly with a razor before each experiment, as otherwise the larvae will hide in the cracks or become squashed between the cork and the glass. The use of cotton-wool plugs is unsatisfactory, as the humidity is then difficult to control, and also the mites burrow into the cotton-wool and become entangled and damaged.

It is possible to determine the species of a larva while still alive, and thus to select species that have not previously been bred. A small ( $\frac{3}{4}$  inch) cover-glass is lowered gently on the larva, which can then be submitted to the high power of the microscope with safety; the larvae can be determined from the keys given in this paper. The larval (and pupal) skins left when the nymph emerges are mounted, and used to check the previous specific determination, although it is not now possible to check the number of the eyes (which must be recorded beforehand); the arrangement of the dorsal setae is also no longer available but this is not a key character. However, unlike some of the Trombidiidae, the number of the eyes is the same in the larvae, nymphs and adults in all the species known to me, and this frequently enables one to make tentative correlations. In addition, in the field, one can frequently make tentative correlations from the times of appearance of the various stages, and the relative numbers of the larval and adult species, e.g., *Microsmaris*. It is also often possible to separate the larval species free in the field by slight differences in colour and rate of progression; these selected larvae are then submitted to the high power of the microscope. Larvae taken parasitic in the field are best not examined with the high power until they detach themselves from the host.

All the figures in this paper were drawn with the aid of a *camera lucida*, the drawings of all the pupae and most of the nymphs being made from the living material. To do this the pupa, or nymph, is placed in a well-slide, and protected by a cover-glass from currents of air (a drop of water from a brush will cause the cover-glass to adhere sufficiently firmly). The nymph can be drawn in the immobile stage prior to ecdysis to pupa II. The specimens suffer no damage if carefully handled and not submitted to too intense illumination. Wherever possible the type material has been used in the descriptions and illustrations. (This is indicated in the text and descriptions of figures.)

In the descriptions, the body lengths are given to the anterior end of the crista in the adult, and to the anterior end of the dorsal scutum in the larva. The leg measurements include the coxae and claws, except in one instance (recorded in the text); the tarsal lengths given are exclusive of the claws.

#### REMARKS ON TAXONOMY.

With the wealth of material that has been obtained at Glen Osmond, plus the collecting that has been done over many parts of Australia, it has been possible to revise the taxonomy of only part of the family, and it has not even been possible to work out completely the taxonomy of the genera considered here. In fact, such may have to wait until the larvae of many of them are known; as in Trombidiidae, the larvae frequently show greater divergences than the adults. The taxonomic revision covered in this paper is set out in the summary at the end.

#### *Key to the Genera of Australian Adult Erythraeidae with Eyes Two on Each Side.*

- A. Dorsal setae modified to an imbricate scaling ..... *Erythrellus*, n. gen.  
Genotype, *Erythrellus imbricatus*, n. sp.

AA. Dorsal setae not modified so.

B. With some highly modified serrate setae on the legs.

C. With a row of stout conical spines on the ventral side of the palpal tibia distally, and some similarly placed on the palpal genu. Serrate setae of legs asymmetrical ..... *Parerythraeus*, n. gen.  
Genotype, *Parerythraeus gregoryi*, n. sp.

CC. Without these conical spines on the palpi. Serrate setae of legs symmetrical ..... *Erythroides*, n. gen.  
Genotype, *Erythraeus serratus* Womersley 1936.

BB. Without serrate setae on the legs ..... *Erythraeus* Latreille 1806  
Genotype, *Acarus phalangoides* de Geer 1778.

Genus ERYTHRELLUS, n. gen.

*Definition*: Erythraeidae with eyes two on each side, and with the dorsal body setae modified to an imbricate scaling.

*Genotype*: *Erythrellus imbricatus*, n. sp.

Larva not known.

ERYTHRELLUS IMBRICATUS, n. sp. Fig. 1, A-H.

*Description of Adult (Type)*: Black dorsally, reddish ventrally on body, and on legs. Body as figured, 1050 $\mu$  long by 740 $\mu$  wide. Crista present, linear, covered over by the imbricate scaling except at the anterior and posterior sensillary areas; distance between

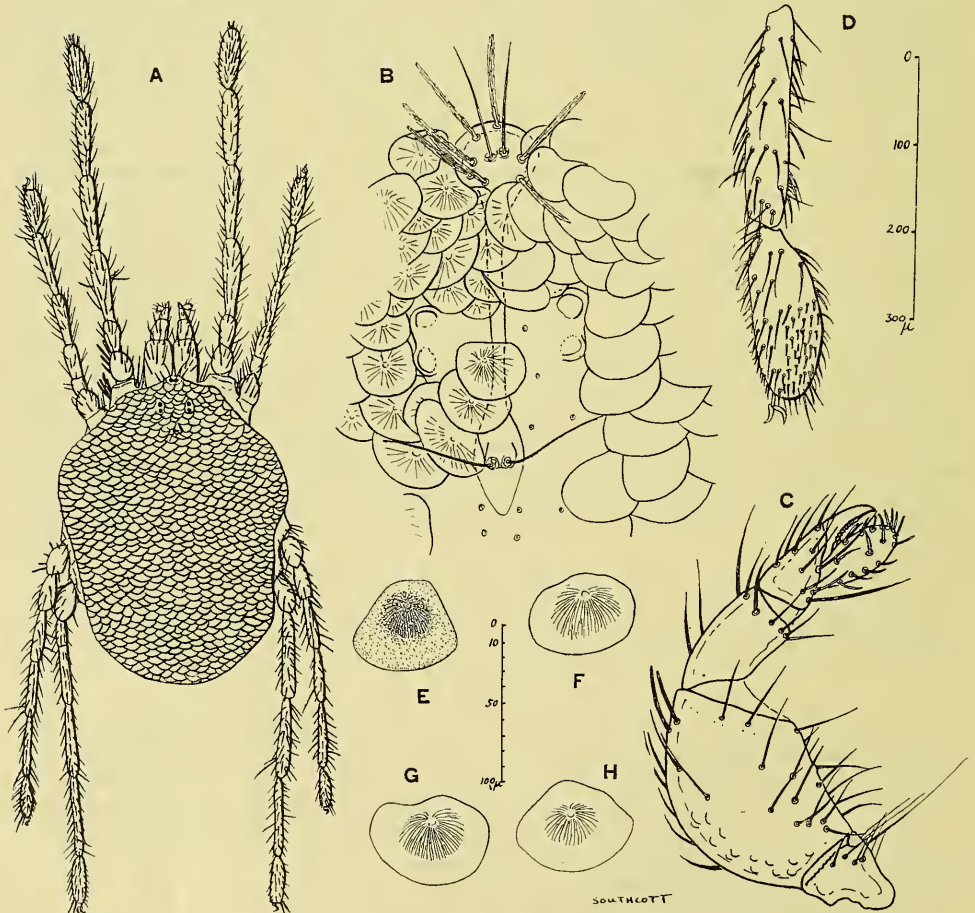


Fig. 1.—*Erythrellus imbricatus*, n. gen., n. sp. A, Dorsal view, entire; B, Anterior region of dorsum, specimen with some scales removed, showing crista and eyes; C, Palp; D, Tarsus I and metatarsus I; E-H, Dorsal setae (pigmentation shown in E only), all to scale shown.

centres of anterior and posterior sensillae  $270\mu$ . Crista continues slightly beyond the posterior sensillary area. Sensillary setae comparatively stout, tapering, pointed, with faint adpressed ciliations, anterior  $104\mu$  long, posterior  $104\mu$  long (in one of the three specimens the posterior sensillary area is completely absent, the crista ending blindly just behind the eyes, and the region where the posterior sensillary area would be expected is covered completely by the typical imbricate scaling). Anterior sensillary area in addition with 6-7 stout, slightly ciliated setae, to  $83\mu$  long. Eyes 2 + 2, behind middle of crista. Dorsal setae highly modified to an imbricate scaling. The scales arise from pedicels which attach excentrally to their under surfaces. On the under surface of the seta, centering on the pedicel, is a fan of striations (see Fig. 1, E-H). The scales are pigmented, and somewhat irregular and variable in shape,  $60-80\mu$  across by  $50-60\mu$  long. Palpi as figured; palpal setae with adpressed ciliations or almost simple. Claw of palpal tibia strong, its ventral edge irregular. Ventral surface of body encroached on only slightly by the scaling, except posteriorly, where the scales extend as far forward as the anus; otherwise venter with spiniform setae with very faint adpressed ciliations, to  $80\mu$  long. Legs with normal setae: leg I  $1620\mu$  long, II  $1230\mu$ , III  $1320\mu$ , IV  $1900\mu$  (all including coxae and claws). Tarsus I  $240\mu$  long by  $75\mu$  high; metatarsus I  $300\mu$  long.

*Localities:* Glen Osmond, South Australia, 3 specimens from débris of leaves and bark at the foot of *Eucalyptus cladocalyx*, 8th Jan., 1939 (1 specimen), 15th Jan., 1939 (1 specimen, type), 16th Jan., 1941 (1); all in author's collection. (All specimens used in the figures.)

*Remarks:* A rare species, only 3 having been found despite regular searching. Each of the 3 specimens was kept alive in a tube for about 3 weeks, but no eggs were laid. Immature eggs about  $300\mu$  long by  $250\mu$  across were present within the adults. At least 2 of the 3 were females, including the type.

#### Genus PARERYTHRAEUS, n. gen.

*Definition:* Eyes two on each side. With highly modified asymmetrically serrate setae on the legs. With a row of stout conical spines on the ventral (flexor) side of the palpal tibia distally, and some similarly placed on the palpal genu. Palpal claw with a single blunt basal tooth.

*Genotype:* *Parerythraeus gregoryi*, n. sp.

Larva not known.

#### PARERYTHRAEUS GREGORYI, n. sp. Fig. 2, A-I.

*Description of Adult (Type):* Red, very large mite. Body oval, length 2.7 mm., width 1.9 mm. Crista linear,  $695\mu$  between centres of anterior and posterior sensillae. Sensillary setae fine, tapering, simple, anterior  $157\mu$  long, posterior  $190\mu$ . Anterior sensillary area also with 10 long non-sensillary setae, some slightly clavate, with ciliations modified to serrations, to  $275\mu$  long. Eyes 2 + 2, behind middle of crista. Dorsal setae pigmented, clavate, dorsally convex with rows of adnate serrations, ventrally with a small ciliated keel, and rows of fine ciliations alongside; dorsal setae  $40-50\mu$  long. Ventral setae not modified, pigmented, tapering, ciliated, to  $80\mu$  long, but longer and thicker over coxae. Palpi as figured, with a row of 7 conical spines along the ventral (flexor) edge of the palpal tibia distally, and 3 more similarly placed distally on the palpal genu. These conical spines are pigmented, roughened ventrally, smooth dorsally (see figure). Setae of palp (except tarsus) somewhat ciliated. Tibial claw smooth except for one broad blunt basal tooth. Legs long: I 6.2 mm., II 4.2 mm., III 5.0 mm., IV 8.8 mm. (all including coxae and claws). Tarsus I  $680\mu$  long by  $235\mu$  high; metatarsus I  $1520\mu$  long. Clothing of legs almost entirely of the asymmetrically serrate setae down to middle of tibiae; a number of these setae are present on the proximal half of the metatarsi dorsally; otherwise tibiae, metatarsi, and tarsi entirely with normal ciliated setae, and a few of these setae on the more proximal segments. Fine spiniform sensory setae are also present on the legs.

*Locality:* Coomalie Creek, Northern Territory, 20th May, 1943, in leaf débris, one specimen, type (R.V.S.); in author's collection.

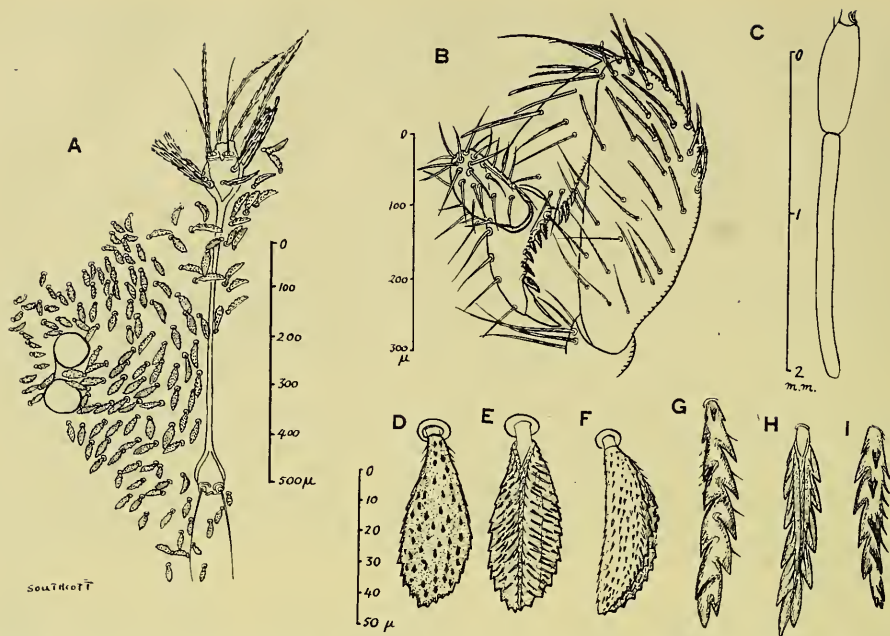


Fig. 2.—*Paverythraeus gregoryi*, n. gen., n. sp. A, Anterior region of dorsum, showing crista and eyes; B, Palp; C, Tarsus I and metatarsus I, outline; D-I, Setae, all to scale shown; D, Dorsal seta from above; E, Same from below; F, Same, side view; G, H, I, Serrate setae from above, below, side. (All figures from the type.)

#### Genus ERYTHROIDES, n. gen.

*Definition*: Eyes two on each side, on distinct shields. With highly modified symmetrically serrate setae on the legs. No spines to the ventral edge of palp. Palpal claw with fine teeth basally. Narrow shield to crista present.

*Genotype*: *Erythraeus serratus* Womersley 1936.

Larva with two eyes on each side. Dorsal scutum somewhat pentagonal, with 3 pairs of non-sensillary setae, and 2 pairs of clavate sensillary setae. One seta to each trochanter. Ventral surface of body with a pair of setae between or just behind the inner angles of coxae I, and one pair of setae between the levels of coxae II and III. Palpal claw with a dorsal tooth. Each coxa with one seta.

Larva known from only *Erythroides clavatus*, n. sp.

#### Key to the Adult Species of *Erythroides*, n. gen.

- A. Dorsal setae convex, considerably expanded, leaf-like.
  - B. Dorsal setae triangular, with blunt serrations .. *Erythroides serratus* (Wom. 1936)
  - BB. Dorsal setae elongate-oval, with numerous fine serrations .. *Erythroides neoserratus*, n. sp.
- AA. Dorsal setae elongate, not or only slightly expanded distally.
  - C. Dorsal setae widest distally (i.e., slightly clavate), heavily pigmented. Cilia-tions absent from proximal part of seta. Serrate setae numerous on metatarsi .. *Erythroides darwini*, n. sp.
  - CC. Dorsal setae somewhat lanceolate, lightly pigmented; serrations present along whole length of seta. Only a few serrate setae present on metatarsi .... *Erythroides macdonnelli*, n. sp.

#### ERYTHROIDES SERRATUS (Womersley 1936). Fig. 3, A-D.

*Erythraeus serratus* Womersley 1936, *J. Linn. Soc. Lond., Zool.*, 40(269): 117.

The type adult (male) was described and figured by Womersley, drawings of the front tarsus and metatarsus being included. The palpi also were figured, the tibial claw being shown as simple. Actually there are fine basal serrations to the tibial claw. The dorsal setae and palp are re-figured here, and the following additional details (from the

type ♂) given: Sensillary setae tapering, with fine adpressed ciliations, posterior sensillary setae  $105\mu$  long. Dorsal setae heavily pigmented, triangular, with heavy serrations,  $24-32\mu$  long; a few of these setae, where the dorsal vestiture is continued over on to the ventral surface posteriorly, near the anus, are unpigmented. The serrate setae of the legs extend over the trochanters to the metatarsi, mingled with the ordinary ciliated leg setae, and more on the extensor side. The serrate setae are not present on the tarsi.

*Localities:* The type ♂ was from Bathurst, New South Wales, 31st May, 1934. This species is found at Glen Osmond, South Australia, in bark and leaf débris at the bases of eucalypts, etc., along with *Erythroides neoserratus*, n. sp. Adults of both species occur during August to January (commonest in November-January), though occasional specimens of *Erythroïdes serratus* have been taken in May and July (survey over 1936-1940).

*Remarks:* See under the remarks for *Erythroides neoserratus*, n. sp., and for the larval *Erythroides clavatus*, n. sp.

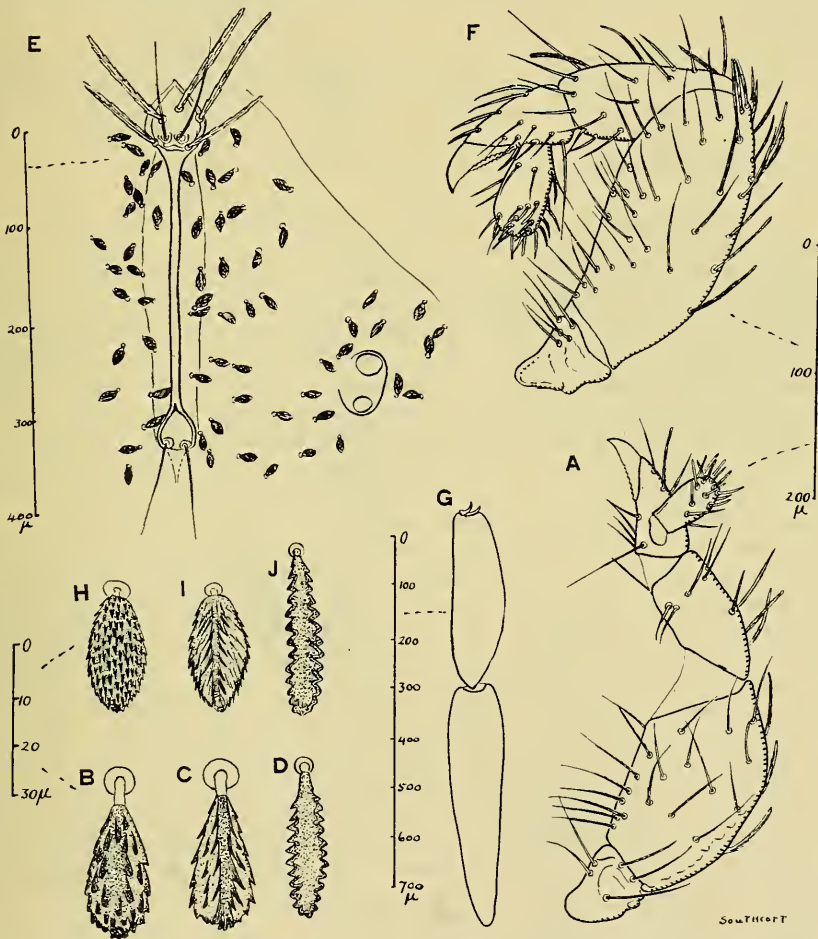


Fig. 3.—A-D, *Erythroides serratus* (Wom. 1936). A, Palp; B, Dorsal seta from above; C, same from below; D, Serrate seta from legs. E-J, *Erythroides neoserratus*, n. sp. E, Anterior region of dorsum; F, Palp; G, Tarsus I and metatarsus I; H, Dorsal seta from above; I, Same from below; J, Serrate seta from leg. (All setae to scale shown; all figures from types.)

ERYTHROIDES NEOSERRATUS, n. sp. Fig. 3, E-J.

*Description of Adult (Type ♂):* Reddish, with white bandings on the hind legs. Body length 1.4 mm., width 1.0 mm. Crista linear, with shield as figured, and the normal



two sensillary areas. Distance between centres of anterior and posterior sensillae  $320\mu$ . Sensillary setae tapering, with fine adpressed ciliations, anterior sensillary setae  $104\mu$  long, posterior  $105\mu$ . Eyes 2 + 2, on distinct shields, behind middle of crista. Dorsal setae heavily pigmented, elongate-oval (not triangular), with numerous fine-pointed ciliations as figured, setae  $16-28\mu$  long. Ventral setae tapering, with adpressed ciliations, to  $70\mu$  long. Palpi as figured, palpal claw basally with fine teeth. Legs long, heavily setose, with white bandings on legs IV: I  $2400\mu$  long, II  $1850\mu$ , III  $2500\mu$ , IV  $4050\mu$  (all including coxae and claws). Tarsus I  $480\mu$  long by  $102\mu$  high, metatarsus I  $500\mu$  long, tarsus IV  $320\mu$  long, metatarsus IV  $1170\mu$  long. All tarsi with scopulae. The serrate setae of the legs are mingled with the normal ciliated setae from trochanters to metatarsi, these serrate setae being mainly on the extensor side; only a few serrate setae are present on the metatarsi, and these proximally; none on tarsi. Numerous short-simple curved sensory setae are also present on the legs. On the distal portion of genu IV and tibia IV the setae are unpigmented, including some serrate setae, giving white bandings, by which this species is easily distinguished from the preceding, macroscopically.

*Localities*: Present along with the preceding species at Glen Osmond, South Australia, in bark and leaf débris, during the summer months; it is commoner than *Erythroides serratus*. See remarks for *Erythroides serratus*, and for *Erythroides clavatus*, n. sp. (larval).

Type ♂ from Glen Osmond, 26th Nov., 1939; in author's collection.

ERYTHROIDES CLAVATUS, n. sp. Figs. 4, A-K; 5, A-C.

*Description of Larva (Type)*. Fig. 4, A-H: Red. Body ovoid, length  $395\mu$ , width  $240\mu$ . Dorsal scutum pentagonal, with rounded angles,  $106\mu$  long by  $132\mu$  wide. Anterior and posterolateral borders of shield are very slightly concave, anterolateral borders are very slightly convex. Shield with 2 pairs of ciliated clavate sensillary setae, anterior  $31\mu$  long, posterior  $40\mu$ ; also with 3 pairs of non-sensillary setae, stout, clavate, ciliated, the anterior 2 are near the anterolateral angles of the shield, length  $59\mu$ , the middle 2 are level with the anterior sensillae,  $47\mu$  long, the posterior 2 are stronger than the other 4, arise at the level of the middle of the shield and are  $58\mu$  long. Eyes 2 + 2, each lateral pair on a distinct shield. Dorsum with about 43 stout clavate ciliated setae,  $46-52\mu$  long, arranged 2, 4, 8, 4, 5, 8, 7, 5; the ciliations are strong, tapering and somewhat blunted (blunted more on the setae distally). Venter: between coxae I 2 setae, simple, pointed,  $50\mu$  long; between the levels of coxae II and III a similar pair  $44\mu$  long; well behind coxae III is a transverse row of 4 clavate ciliated setae  $37-39\mu$  long; arranged around the periphery of the posterior pole of the body ventrally are about 10 ciliated clavate setae  $40-41\mu$  long. Seta on coxa I arises at its posterolateral angle, curved, pointed, ciliated,  $94\mu$  long; seta on coxa II arises near its posterolateral angle, straight, blunt, ciliated,  $42\mu$  long; that on III arises near the centre of the coxa, slightly curved, blunt, ciliated,  $50\mu$  long. Legs long and thin: I  $772\mu$  long, II  $777\mu$ , III  $960\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $125\mu$  long by  $28\mu$  high; empodium strong, falciform, ridged; anterior claw with a straight shaft and terminal hook, the shaft with many ventral ciliations, and with 8 teeth or adpressed ciliations along its dorsal edge; posterior claw retroflexed and with many branching ventral ciliations. Almost all the setae of the tarsus are curved, long, strongly ciliated. Metatarsus I  $186\mu$  long. Capitulum as figured. The posterior pair of hypostomal setae are ciliated. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 7 setae respectively. Palpal claw with a dorsal tooth. Palpal tarsus as figured.

*Description of Post-Larval Pupa (Pupa I)*. (ACA 360). Figs. 4, I-K; 5, A, B: Red. Length  $600\mu$ , width  $350\mu$ . Shape ovoid, evenly rounded posteriorly, rather pointed anteriorly, and there notched, ventral surface flattened. With a number of fairly strong, slightly tapering, blunted, slightly curved setae, with adpressed ciliations nearer the proximal end of the seta, and with freer ciliations distally; each seta arising from a papilla; setae  $22-62\mu$  long.

*Description of Nymph*. (ACA 1013). Fig. 5, C: Red. Body  $540\mu$  long,  $410\mu$  wide. Crista normal; sensillary setae tapering, with fine adpressed ciliations, anterior sensillary

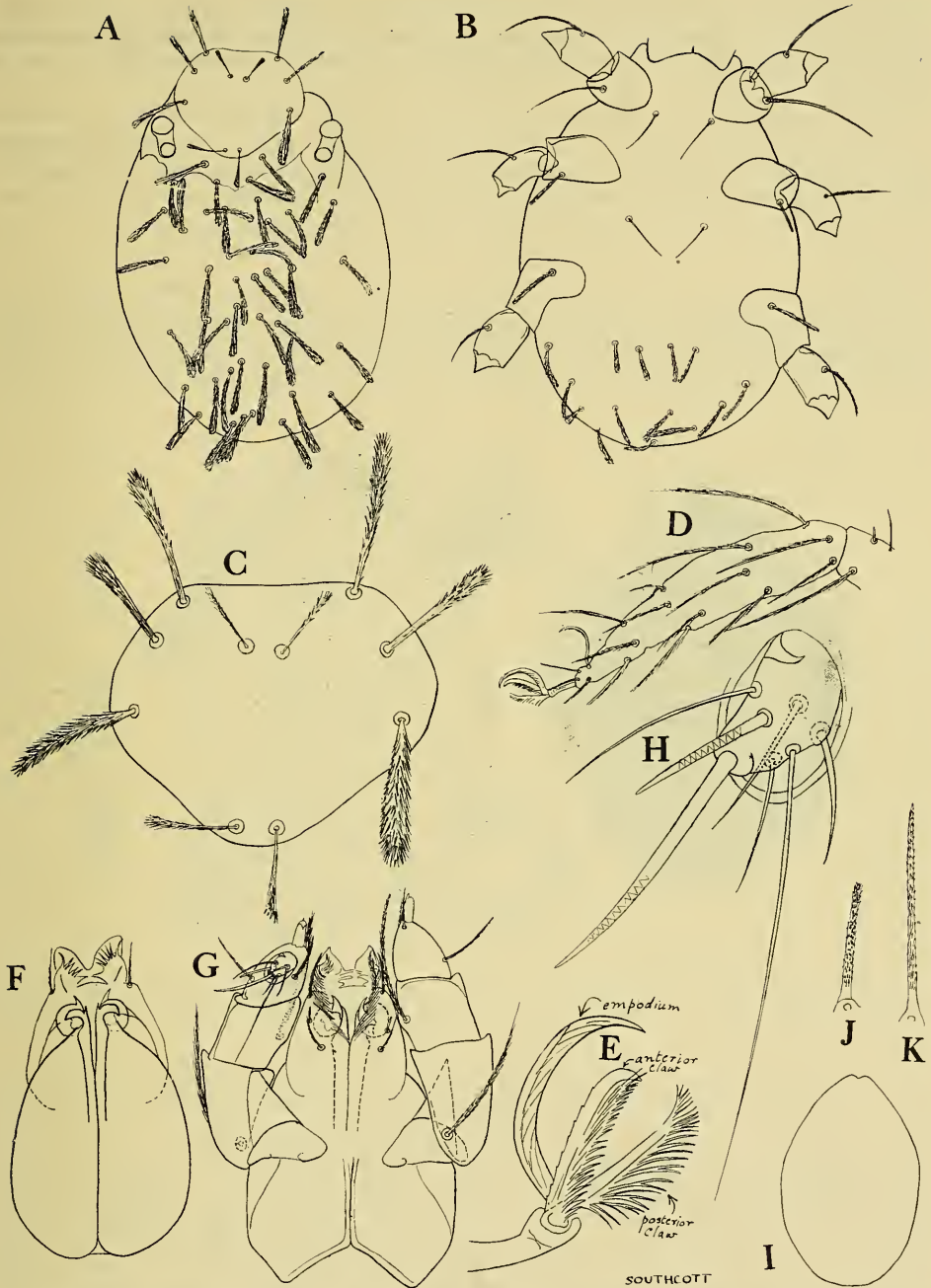


Fig. 4.—*Erythroides clavatus*, n. sp. A-H, Larva. A, Dorsum; B, Venter; C, Dorsal scutum; D, Tarsus I; E, Tip of tarsus I; F, Capitulum from above; G, Same from below (with dorsal view of palp on right); H, Palpal tarsus; I-K, Post-larval pupa (pupa I). I, K. Setae. (Figures A-H from type larva, I-K from ACA 360; see text.)

setae  $90\mu$  long, posterior  $96\mu$  long. Distance between centres of anterior and posterior sensillae  $204\mu$ . Eyes  $2+2$ , each lateral pair on a distinct shield. Palpal claw basally with fine teeth. Dorsal setae as in Fig. 5, C, pigmented, with blunted serrations,  $14-18\mu$  long, some longer near the nasus to  $28\mu$ . Distribution of serrate setae on the legs as for

*Erythroides serratus* and *Erythroides neoserratus*, n. sp., some being unpigmented on legs III and IV. Legs long: I  $1450\mu$  long, II  $1050\mu$ , III  $1350\mu$ , IV  $2700\mu$  (all including coxae and claws). Tarsus I and metatarsus I not available for measurement. Tarsus IV  $182\mu$  long.

*Localities*: All specimens so far have been taken at Glen Osmond, South Australia, in soil and leaf débris at the base, or on the trunk or under bark, of *Eucalyptus rostrata*: 11th Nov., 1937 (1 specimen), 21st Dec., 1937 (2 specimens, one the type), 26th Nov., 1939 (1 specimen, ACA 360, see below), 9th Nov., 1941 (3 specimens, ACA 1012, 1013, 1014, see below); also 2 specimens, Sept.-Nov., 1937 (see ACA 212, below).

*Biology*.

1. Tube ACA 212. An adult *Erythraeus urrbrae* was taken at Glen Osmond on 1st Aug., 1937, and put in a tube with some unsterile soil from the same situation (base of *Eucalyptus rostrata*). On 14th Aug., 1937, the soil was replaced with soil from the same situation; no eggs were seen. On 22nd Aug., 1937, a batch of eggs was seen in the

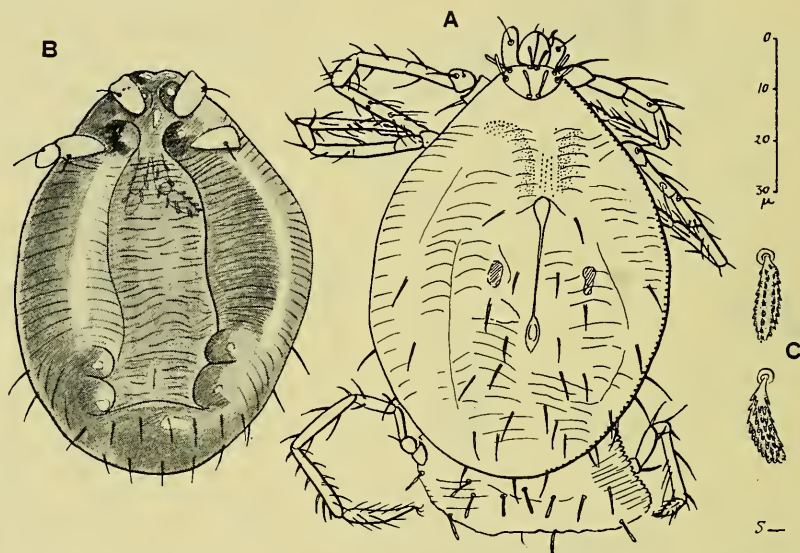


Fig. 5.—*Erythroides clavatus*, n. sp. A, Post-larval pupa (pupa I) with cast larval skin still attached; B, Same from below; C, Nymph, dorsal setae (to scale above) (all figures from ACA 1013; see text).

tube; these were unhatched on 11th Sept., 1937, and the adult *Erythraeus urrbrae* was dead. On 13th Nov., 1937, the tube was emptied out and the contents examined carefully: the dead adult *Erythraeus urrbrae*, 2 dead *Erythroides clavatus*, n. sp. (larval), 28 dead *Leptus anomalus*, n. sp. (larval), and 20 unhatched eggs were found. Nine eggs were mounted and 11 were kept, but no further eggs hatched out. Unsterile soil was used on the assumption that it would provide food for the adult. Elsewhere in this paper the larva of *Erythraeus urrbrae* is described, and also the nymph of *Erythroides clavatus*, n. sp. The adult of *Leptus anomalus*, n. sp. is not known. Presumably the second lot of soil added to the tube contained a mixed batch of eggs; no other mites were found at the final examination.

2. Larva ACA 360, from Glen Osmond, 26th Nov., 1939, was plump, body length  $570\mu$ , width  $340\mu$ . It became immobile on 27th Nov., 1939; the larval skin split off on 4th Dec., 1939, revealing pupa I, which was unfortunately damaged (and killed) a few days later.

3. Three larval specimens were taken free on 9th Nov., 1941. ACA 1012 and ACA 1014 lived for a few days only, although jassids were provided as hosts. ACA 1013 was plump when taken, body length  $720\mu$ , width  $490\mu$  (i.e., partly fed at least). Several small yellow

jassids were given to act as hosts, and water also. The mite did not attach to any and became immobile on 11th Nov., 1941. It cast its skin on 14th Nov., 1941, revealing pupa I, which was drawn with the aid of a *camera lucida* (Fig. 5, A, B) on 23rd Nov., 1941: length 700 $\mu$ , width 510 $\mu$ . The nymph (described above) hatched out on 26th Nov., 1941. It was given food (insects) and water, but died on 3rd Dec., 1941. Thus the pupa I stage lasted 12 days.

*Remarks*: I am not prepared to correlate specifically the nymph obtained (ACA 1013) with either of the two adult *Erythroides*—*E. serratus* and *E. neoserratus*, n. sp.—occurring at the same situation. The nymphal dorsal setae are not sufficiently like those of either of these two species for a correlation to be proposed.

The scutal setae of the larvae are subject to some variation, e.g., one or both of the anterior sensillary setae or one of the posterior sensillary setae may be only very slightly clavate; hence no great reliance can be placed on this variation as a specific character. Despite the fact that nine larval specimens have been obtained, it has not been possible to separate out another species, though two adult species occurred in fair numbers in the same situation. Further work there later may reveal a second species.

At present, therefore, this larva must be given a separate specific name. The distinct character of the scutal sensillary setae being clavate, plus the pentagonal shape of the scutum, confirms the separation of *Erythroides*, n. gen., from *Erythraeus* s. str.

(All specimens in author's collection.)

*ERYTHROIDES DARWINI*, n. sp. Fig. 6, A–G.

*Description of Adult (Type)*: Red. Body oval, length 1.5 mm., width 1.1 mm. Crista linear, with shield as figured. Two sensillary areas to crista, each with 2 sensillary setae with fine adpressed ciliations; anterior sensillary setae 125 $\mu$  long, posterior 127 $\mu$  long. Distance between centres of anterior and posterior sensillae 325 $\mu$ . Anterior sensillary area also with some long strong ciliated setae as figured. Eyes 2+2, each lateral pair on a distinct shield. Dorsal setae elongate, slightly clavate, heavily pigmented, with strong ciliations distally; setae 34–57 $\mu$  long, the more posterior setae the longer. Ventral setae tapering, pointed, finely ciliated, to 90 $\mu$  long. Palp as figured, palpal claw basally with fine teeth. Legs: I 2650 $\mu$  long, II 1950 $\mu$ , III 2400 $\mu$ , IV 4300 $\mu$  (all including coxae and claws). Tarsus I 350 $\mu$  long by 112 $\mu$  high; metatarsus I 540 $\mu$  long; tarsus IV 310 $\mu$  long; metatarsus IV 1450 $\mu$  long. Clothing of legs excluding coxae and tarsi almost entirely of serrate setae; the serrate setae distally on the legs with more and finer serrations than those more proximally placed. Some unpigmented setae present on tibiae IV. The normal (ciliated) leg setae are commoner on the flexor and distal parts of the segments, especially the tibiae, as well as being on the tarsi. No serrate setae on the tarsi. Numerous fine sensory setae are also present on the legs.

*Locality*: A single adult specimen (type) from Adelaide River, Northern Territory, 13th Apr., 1943 (R.V.S.); in author's collection.

*Remarks*: Close to the following species, but differs as indicated in key.

*ERYTHROIDES MACDONNELLI*, n. sp. Fig. 6, H–M.

*Description of Adult (Type)*: Red. Body shape normal, length 1050 $\mu$ , width 930 $\mu$ . Crista normal, 285 $\mu$  between centres of anterior and posterior sensillae. Sensillary setae tapering, with fine ciliations, anterior 94 $\mu$  long, posterior 127 $\mu$ . Eyes 2+2, each lateral pair on a distinct shield. Dorsal setae elongate-lanceolate, frequently curved slightly distally, with serrations along the whole length of the seta, setae keeled ventrally, lightly pigmented, 49–68 $\mu$  long. Palp as figured, claw basally with a few very fine teeth. Legs: I 2300 $\mu$  long, II 1350 $\mu$  (approx.), III and IV missing (lengths including coxae and claws). Tarsus I 290 $\mu$  long by 83 $\mu$  high; metatarsus I 510 $\mu$  long. Serrate setae of legs fairly numerous, absent from coxae and tarsi, and only a few present on metatarsi.

*Locality*: One gravid ♀ (type) from Alice Springs, Northern Territory, 21st July, 1942 (R.V.S.); in author's collection.

*Remarks*: Type ♀ contained many spheroidal to ovoid eggs, average size 205 $\mu$  long by 135 $\mu$  across. This species is close to the preceding; distinguished as in key.

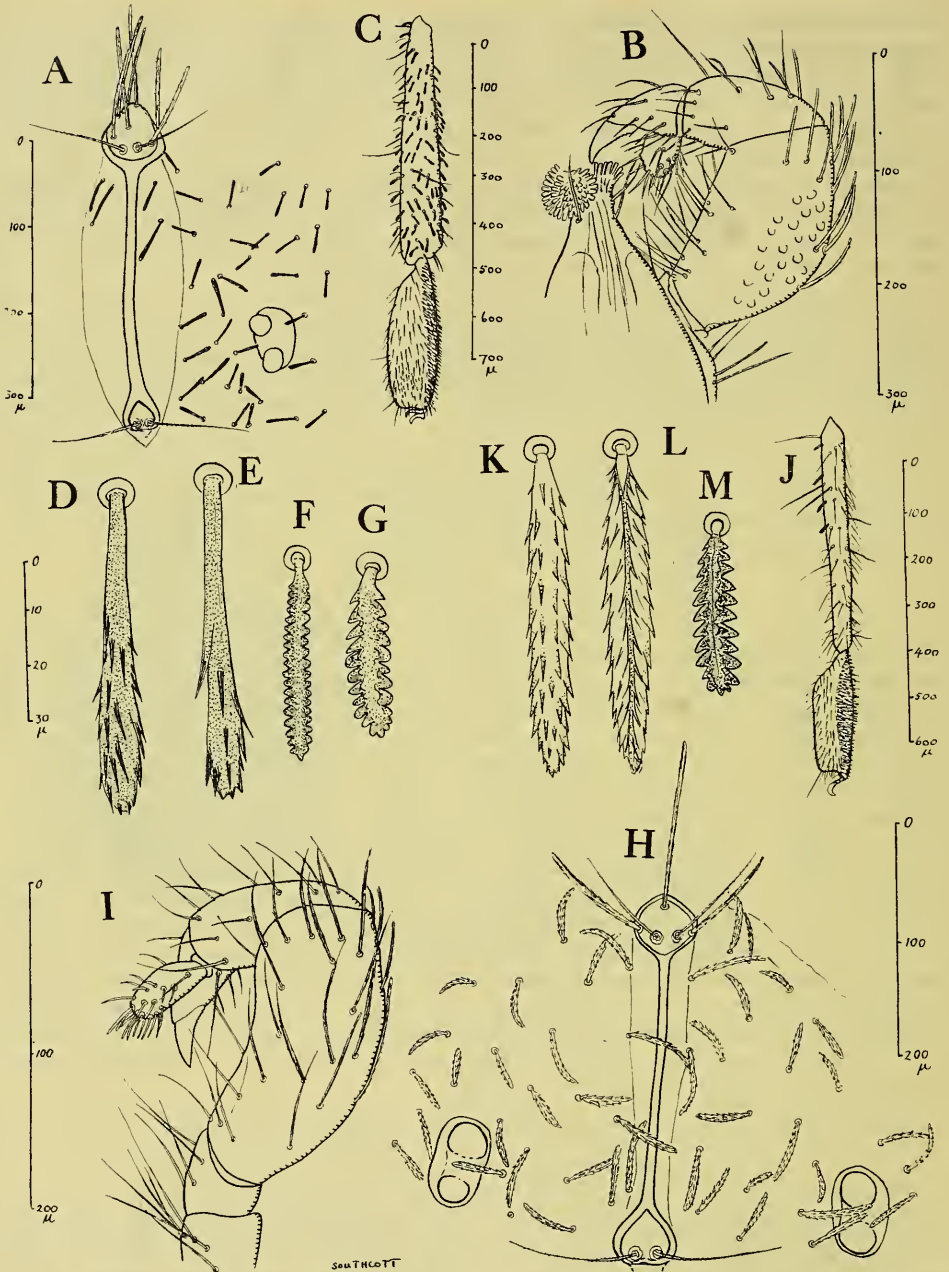


Fig. 6.—A-G, *Erythroides darwini*, n. sp. A, Anterior region of dorsum; B, Mouth-parts and palp from above (fimbriated lip bent back on left); C, Tarsus I and metatarsus I; D, E, Posterior dorsal setae; F, G, Serrate seta from metatarsus I; H-M, *Erythroides macdonnelli*, n. sp. H, Anterior region of dorsum; I, Left palp, lateral aspect; J, Tarsus I and metatarsus I; K, L, Posterior dorsal seta from above; L, Same from below; M, Serrate seta from leg. (All setae to the scale shown on the left; all figures from types.)

Genus ERYTHRAEUS Latreille 1806.

*Gen. Crust. Ins.*, 1: 146.

*Bochartia* Oudemans 1910, *Ent. Ber. Amsterdam*, 3: 49; 1912, Womersley 1934, *Rec. S. Aust. Mus.*, 5: 251; 1936.

[non] *Erythroaeus* (larval) Oudemans 1912, Womersley 1934.

Prior to the separation of the new genera *Erythrellus*, *Parerythraeus* and *Erythroides* in this paper, *Erythraeus* included all Erythraeidae with two eyes on each side. The adult generic characters of *Erythraeus s. str.* may now be given as: Eyes 2 on each side. Dorsal setae not modified to an imbricate scaling. Palp simple, there being no conical spines distally on its ventral (flexor) side. Without highly modified serrate setae on the legs.

*Re-definition of Larval Characters of Genus Erythraeus:* Eyes 2 on each side. Dorsal scutum generally rounded; flattened or concave anteriorly. Dorsal scutum with 2 pairs of sensillary setae, the anterior pair a little behind the anterior border of the shield, the posterior pair on the posterior border of the shield. Scutum with 2 or 3 pairs of non-sensillary setae, 1 or 2 pairs being placed anteriorly, near the edge of the shield, the hind pair at about the middle of the shield, near the edge. Each coxa with one seta. Legs with 6 segments. Tarsus with a strong falciform empodium and 2 lateral dissimilar modified claws: anterior claw ciliated, with a weak terminal hook, posterior claw retroflexed. Palpal coxa, femur, genu, tibia, tarsus with 0, 1, 1, 3, 7-8 setae respectively.

### *Biology.*

The larvae attach themselves to any exposed portion of the jassid (Homoptera) or other host, e.g., head or thorax (contrast *Callidosoma* larva).

#### *Key to the Australian Adults of Genus Erythraeus.*

- A. Palpal tibia an equilateral cone. Dorsal setae of male and female dissimilar. Dorsal setae of female in two sizes.
- B. Male dorsal setae fine, spiniform, simple, 30-35 $\mu$  long. Female longer dorsal setae with only a few ciliations, and these at tip.  
Eastern Australia ..... *E. celeripes* (Rainbow 1906)
- BB. Male dorsal setae stouter, strongly ciliated 40-60 $\mu$  long. Female longer dorsal setae with ciliations along their entire length.  
Type locality, Lucindale, South Australia ..... *E. imperator* (Hirst 1923)
- AA. Palpal tibia is generally twice as long as its basal width. Dorsal setae in male and female alike.
- C. Dorsal setae leaf-like.
- D. Without conspicuous white spots on the dorsal surface of the body. Colour red or reddish.  
Type locality, Adelaide, South Australia ..... *E. regina* (Hirst 1923)  
Type locality, Tanunda, South Australia .....  
..... *E. antepodianus* (Hirst 1923)  
(For further differentiation see in text.)
- DD. With conspicuous white spots on a background of black setae; one large circular white area completely surrounding the posterior sensillary area of the crista.  
Type locality, Glen Osmond, South Australia ..... *E. guttatus*, n. sp.
- CC. Dorsal setae elongate.
- E. Dorsal setae taper to a very fine sharp point, ciliated.  
Type locality, Dubbo, New South Wales. Also found at Glen Osmond, South Australia ..... *E. pilosus* (Hirst 1928)
- EE. Dorsal setae blunted at tip, ciliated.  
Type locality, Adelaide, South Australia .....  
..... *E. urbrae* Womersley 1934

#### *Key to the Australian Larvae of Genus Erythraeus.*

- A. Dorsal scutum with 2 pairs of non-sensillary setae. Each trochanter with 2 setae. Palpal claw trifurcate.  
Type locality, Adelaide, South Australia ..... *E. oudemansi* (Womersley 1936)
- AA. Dorsal scutum with 3 pairs of non-sensillary setae. Each trochanter with one seta. Palpal claw bifurcate.
- B. With 2 pairs of setae on the ventral surface of the body between capitulum and coxae III.
- C. Dorsal setae 30-50 $\mu$  long.
- D. Some or all tarsal setae ciliated.
- E. Ventral setae of tarsus ciliated, dorsal setae of tarsus not ciliated.
- F. Scutum evenly rounded except anteriorly. Dorsal setae not or scarcely expanded distally, with ciliations modified to dagger-like scales, these being blunted distally, more pointed proximally. Anterior sensillary

- setae  $66\mu$  long, posterior  $74\mu$ . Dorsal setae  $35-45\mu$  long.  
 From Glen Osmond, South Australia .....  
 ..... *E. reginae* (Hirst 1928)
- FF. Dorsal scutum squarish, with slightly concave sides behind the middle. Dorsal setae somewhat expanded distally, feather-shaped, ciliations more pointed than in preceding. Anterior sensillary setae  $39\mu$  long, posterior  $54\mu$ . Dorsal setae  $24-34\mu$  long.  
 Type locality, Attack Creek, Northern Territory ....  
 ..... *E. stuarti*, n. sp.
- EE. All tarsal setae ciliated.  
 Type locality, Glen Osmond, South Australia .....  
 ..... *E. osmondensis*, n. sp.
- DD. Tarsal setae not ciliated. Anterior sensillary setae  $94\mu$  long, posterior  $68\mu$ .  
 Larvae from Glen Osmond, South Australia .....  
 ..... *E. pilosus* (Hirst 1928)
- CC. Dorsal setae  $50-85\mu$  long. All setae of tarsus ciliated.  
 Larvae from Adelaide, South Australia ..... *E. urrbrae* Womersley 1934
- BB. With 3 pairs of setae on the ventral surface of the body between capitulum and coxae III. All tarsal setae simple. Dorsal setae to  $50\mu$  long. Anterior sensillary setae  $47\mu$  long; posterior  $61\mu$ .  
 Type locality, Glen Osmond, South Australia ..... *E. womersleyi*, n. sp.

ERYTHRAEUS CELERIPES (Rainbow 1906). Fig. 7, A-C.

*Rhyncholophus celeripes* Rainbow 1906, *Rec. Aust. Mus.*, 6: 156.

*Erythraeus celeripes* Womersley 1934 (part), *Rec. S. Aust. Mus.*, 5 (2): 218.

This species was originally described by Rainbow from Enfield, New South Wales. In 1934 Womersley synonymized Hirst's *Leptus imperator* (1928) from Lucindale, South Australia, with this species, and gave a fresh description with figures, based on Rainbow's material. Hirst's species is, however, quite distinct, as can be seen from the figures of the dorsal setae for the two species (see Fig. 7). Hirst's species is re-described in the following pages as *Erythraeus imperator*. Womersley refers to the dorsal setae of *E. celeripes* as short and spiniform in the text (i.e., p. 219), but in the key (p. 222) records them as long. The confusion was due to the fact that in *E. celeripes* and *E. imperator*, unlike other members of the genus, there are marked differences between the dorsal setae of male and female. Womersley's figure of the short dorsal setae of *E. celeripes* was from the male.

The following additional details of description for the adult *E. celeripes* are given (from Rainbow's type material): Sensillary setae of crista filiform, anterior  $146\mu$  long, posterior  $170\mu$  long. Distance between centres of anterior and posterior sensillae  $670\mu$ . (Crista of this ♂ syntype is  $970\mu$  long; a ♀ syntype  $640\mu$ ,  $920\mu$  respectively.) Dorsal setae of ♂ uniform, short, curved, spiniform (indistinctly ciliated),  $30-35\mu$  long; ♀ dorsal setae in two distinct sizes, longer setae  $160-180\mu$  long, tapering, spiniform, with a few indistinct terminal ciliations, the shorter setae are similar, only indistinctly ciliated, about  $70-90\mu$  long. Palpal tibia, claw and tarsus extremely short. Claw of palpal tibia smooth ventrally except for a basal small single tooth.

*Locality*: Rainbow's material from Enfield, New South Wales "at all seasons of the year".

*Remarks*: See under the following species.

ERYTHRAEUS IMPERATOR (Hirst 1928). Fig. 7, D-F.

*Leptus imperator* Hirst 1928, *Ann. Mag. nat. Hist.*, (10) 1 (4): 570.

*Erythraeus celeripes* Womersley 1934 (part), *Rec. S. Aust. Mus.*, 5(2): 218.

*Re-description of Adult ♀ (Type)*. Fig. 7, D, E: Red. Body oval, length 2.5 mm., width 1.65 mm. Crista linear, the anterior sensillary area being produced into a long blunt-pointed nasus carrying many long setae with adpressed ciliations. Length of nasus  $350\mu$ . Sensillary setae of crista long, strong, tapering, only very indistinctly ciliated, anterior  $146\mu$  long, posterior (missing in type)  $200\mu$  long. Crista continues beyond posterior sensillary area. Distance between centres of anterior and posterior sensillae  $900\mu$ . Eyes 2 + 2, behind middle of crista. Dorsal setae of ♀ in two sizes, the distinction

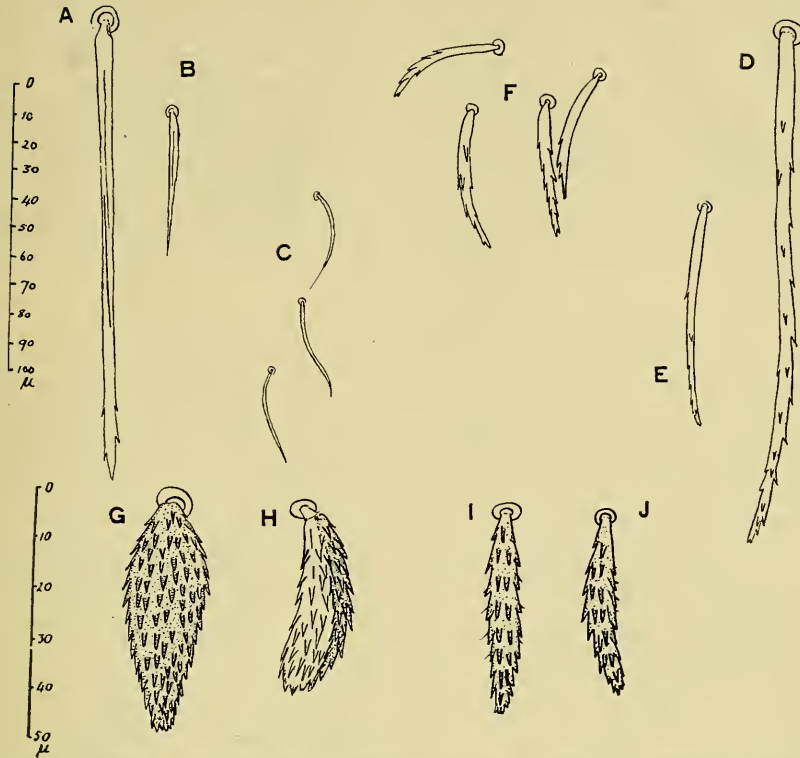


Fig. 7.—A-C, *Erythraeus celeripes* (Rainbow 1906). A, Adult ♀, longer dorsal seta; B, Adult ♀, shorter dorsal seta; C, Adult ♂, group of dorsal setae. D-F, *Erythraeus imperator* (Hirst 1928). D, Adult ♀, longer dorsal seta; E, Adult ♀, shorter dorsal seta; F, Adult ♂, group of dorsal setae. G-J, *Erythraeus reginae* (Hirst 1928). G, Adult, dorsal seta from above; H, Same from side; I, J, Nymph, dorsal setae. (Figs. A-E, G, H, from type material.)

between the two sizes not being as clear as in *E. celeripes*; longer 150–200 $\mu$  long, stout, ciliated along entire length, shorter setae about 80 $\mu$  long, comparatively less ciliated. (Dorsal setae of a ♂ specimen from Glen Osmond, Fig. 7, F, uniform, stout, heavily ciliated, 40–60 $\mu$  long.) Palp similar to that of *E. celeripes*—with a very short tibia, claw, tarsus (which is almost hemispherical); tibial claw smooth, but a blunt protuberance is present basally, ventrally. Legs fairly stout for the genus: I 6.5 mm. long, II 3.9 mm., III 4.6 mm., IV 6.7 mm. (all including coxae and claws). Tarsus I 680 $\mu$  long by 300 $\mu$  high; metatarsus I 1370 $\mu$  long. All tarsi almost oval, and with ventral scopulae.

*Localities*: Type ♀ (Hirst) was from Lucindale, South Australia. The species is not uncommon at Glen Osmond, South Australia, under the bark of eucalypts (*Eucalyptus rostrata* especially) rather than in soil. Nymphs are also obtained by sweeping foliage of *Eucalyptus rostrata*.

#### Biology.

Adults taken at Glen Osmond and elsewhere around Adelaide lay eggs in late October, and November. They are laid in one or two large batches; orange-red when first laid; however, the chorion rapidly blackens. Eggs measure on average 420 $\mu$  long by 300 $\mu$  wide. None of the eggs laid thus have hatched, all either drying out when kept dry, or going mouldy when kept moist. None has progressed to the deutovum stage. The eggs are spheroidal, smooth, polished, but later develop protuberances indicating partial development. Nymphs are found from May to September, under bark and in foliage of *Eucalyptus rostrata*. Adults begin to appear in July (rare), with greatest numbers in October–November, and have disappeared by mid-December.



*Remarks:* The larva is unproven, but is in all probability *Erythraeus oudemansi* (Wom. 1936) (larval) (q.v., remarks).

*Erythraeus celeripes* and *E. imperator* are very distinct from the other Australian members of the genus, as at present constituted, in the great shortening of the terminal segments—tibia and tarsus—of the palp, also in that there is a marked sexual dimorphism in the dorsal setae, not seen in other *Erythraeus*. Probably subsequently they will have to be separated generically, but the author is not prepared to do this until the larva is known for certain (see also remarks for *Erythraeus oudemansi*).

Collecting has been done by the author at Glen Osmond, from 1936 to 1940. The type is in the South Australian Museum. Other specimens recorded, in the author's collection.

ERYTHRAEUS OUEMANSI (Womersley 1936). Fig. 8, A-G.

*Bochartia oudemansi* Womersley 1936, *J. Linn. Soc. Lond., Zool.*, 40 (269): 121.

*Re-description of Larva (Type).* Fig. 8, A-G: Red. Body ovoid, length 1176 $\mu$ , width 910 $\mu$ . Dorsal scutum evenly rounded posteriorly, concave anteriorly, with rounded anterolateral angles, length 173 $\mu$ , width 167 $\mu$ . Scutum with 2 pairs of ciliated sensillary setae, anterior 45 $\mu$  long, posterior 89 $\mu$ ; with 2 pairs of non-sensillary setae, stout, ciliated, anterior pair placed very slightly anterior to the anterior sensillae, 64 $\mu$  long, posterior pair at the level of the middle of the shield, 70 $\mu$  long; Eyes 2+2, each lateral pair on a distinct shield, just posterior and lateral to the scutum. Dorsum with about 124 setae, stout, blunt, strongly ciliated, 40-95 $\mu$  long, the posterior setae being the longer; the ciliations are strong, acute. Setae arranged in obscure lines across the dorsum. Venter: just behind coxae I a pair of tapering pointed very slightly ciliated setae 75 $\mu$  long; between the levels of coxae II and III a similar pair 52 $\mu$  long; behind coxae III about 45 setae, the anterior of these being pointed, finely ciliated, 47-79 $\mu$  long, the posterior setae blunt, ciliated, 52-70 $\mu$  long. Each coxa with one seta: on I arising near its posterolateral angle, ciliated, pointed, 129 $\mu$  long; on II arising near middle of its posterior border, ciliated, blunt, 37 $\mu$  long; on III arising near middle of its anterior border, ciliated, blunt, 61 $\mu$  long. Legs long and thin: I 1340 $\mu$  long, II 1255 $\mu$ , III 1550 $\mu$  (all including coxae and claws). Each trochanter with 2 setae. Tarsus I 184 $\mu$  long by 25 $\mu$  high, strongly chitinized, and provided with a strong tapering pointed sensory rod, with very fine adpressed ciliations, and which arises from a pit at the distal end of the dorsum of the tarsus; all the other setae of the tarsus are ciliated; tarsal empodium is strong, ridged, falciform and over-reaches the two lateral claws; anterior claw bent over ventrally terminally; it has many branching ventral ciliations and a number of fine adpressed dorsal ciliations; posterior claw is brush-like with branching ventral ciliations. Metatarsus I 350 $\mu$  long. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 7 setae respectively. Palpal claw trifurcate. Palpal tarsus as figured.

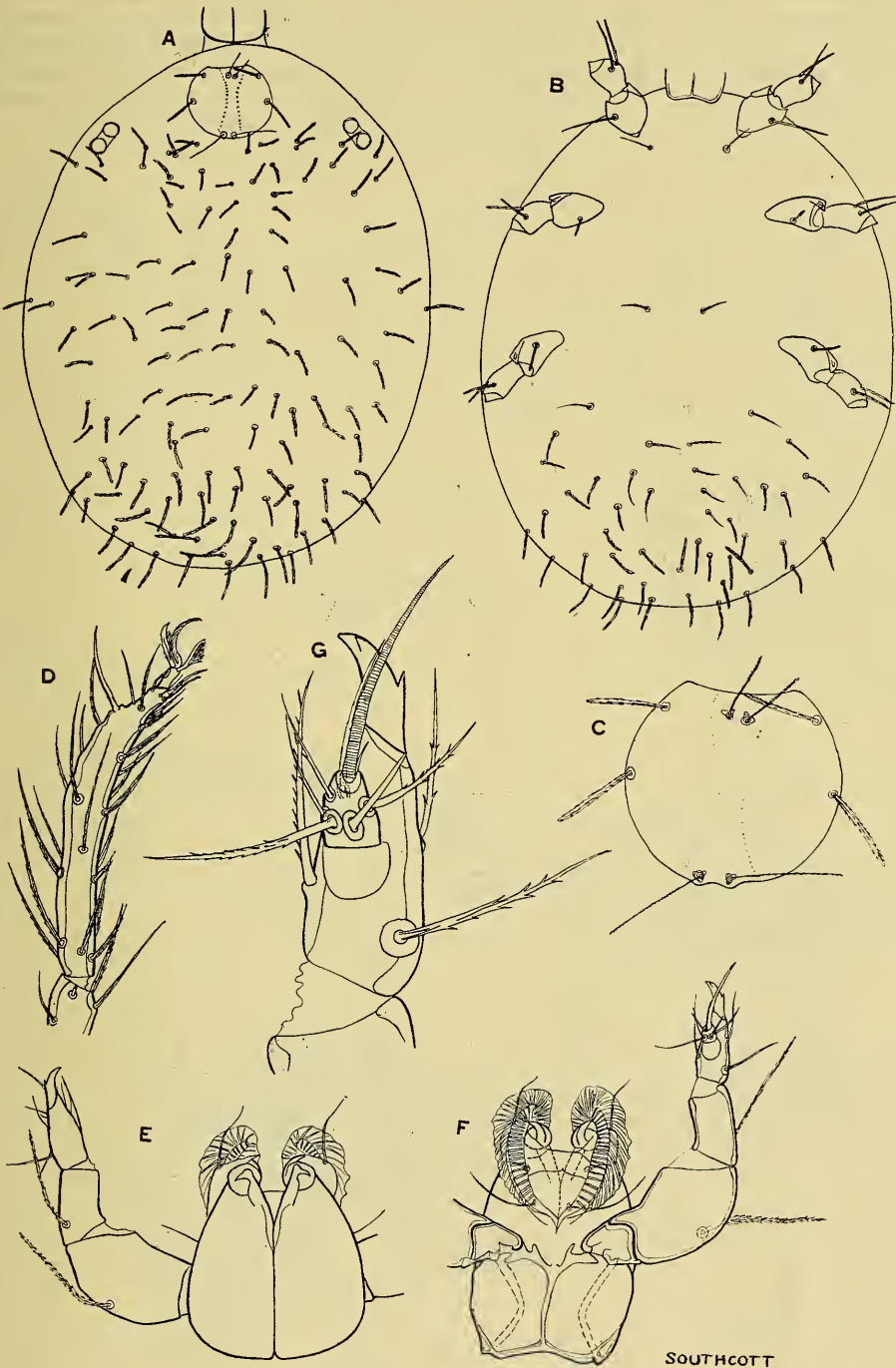
*Localities:* Type specimen from Adelaide, South Australia, 1934 (H. Womersley); Glen Osmond, South Australia, occurring throughout March-May, commonest in April, many specimens, in soil, on trunk or under bark of *Eucalyptus rostrata*, from 1935 to 1940 (R.V.S.); specimens also collected in Adelaide (R.V.S.).

*Biology.*

This is the largest larval erythraeid mite found at Glen Osmond. I have never taken it parasitic in the field, nor have I been able to feed it or get it to parasitize any host. The larvae are found in fair numbers. Fully-fed larvae are rarely taken in the field (I have seen only 2 such specimens; one is the type).

*Remarks:* A comparison of the times of occurrence of this larva with those of the nymphs and adults of *Erythraeus imperator* at the same tree at Glen Osmond suggests strongly that *E. oudemansi* (Wom. 1936) is the larva of *E. imperator* (Hirst 1928). *E. oudemansi* also is the largest larva occurring there, all others being much smaller. *E. imperator* is the largest adult occurring there, and its eggs are large, being the only ones for the species of *Erythraeus* at that situation comparable in size with the larval *E. oudemansi*. At the situation, in addition, the larvae of all the adults of *Erythraeus*

have been worked out, except 2 species—*E. imperator* and the much smaller *Erythraeus guttatus*, n. sp. (q.v.).



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Fig. 8.—*Erythraeus oudemansi* (Womersley 1936). A, Dorsum of fully-fed specimen (type); B, Venter of same; C, Dorsal scutum; D, Tarsus I; E, Capitulum from above; F, same from below; G, Tip of palp. (All figures from type.)

Despite the virtual certainty of *imperator* and *oudemansi* being identical, the author is not prepared to synonymize them until the relationship is proved experimentally.

*E. oudemansi* differs considerably from the other larvae of the genus found at Glen Osmond, in having only 2 pairs of non-sensillary setae to the scutum (like the genotype of *Bochartia* Oudemans 1910—*B. kuyperi* Ouds. 1910), 2 setae to the trochanters, and in that the palpal claw is trifurcate, not bifurcate, and probably subsequently it will have to be generically separated from *Erythraeus* s. str.



Fig. 9.—*Erythraeus reginae* (Hirst 1928). Larva. A, Dorsum; B, Venter; C, Tarsus I; D, Capitulum from above, less palpi; E, Capitulum from below (with dorsal view of palp on right); F, Palpal tarsus.

The most promising method of rearing this larva to the nymphal stage appears to be by capturing the rare fully-fed larvae in the field as was done with *Microsmaris* and other Erythraeidae. The type specimen is a large well-fed mite; unfed specimens measure 500–600 $\mu$  long by 370–430 $\mu$  wide. One from Glen Osmond 25th Mar., 1936, was 1300 $\mu$  long by 770 $\mu$  wide.

Type in the South Australian Museum; the other specimens in author's collection.

ERYTHRAEUS REGINÆ (Hirst 1928). Figs. 7, G–J; 9, A–F; 10, A, B; 11, A–G.

*Leptus reginae* Hirst 1928, *Ann. Mag. nat. Hist.*, (10) 1(4): 569.

*Erythraeus reginae* Womersley 1934, *Rec. S. Aust. Mus.*, 5(2): 219.

*Adult*. Fig. 7, G, H: This was originally described by Hirst from material from Adelaide, South Australia, without figures. It was re-described and figured by Womersley. The dorsal setae are re-figured here. Additional description from the syntype material: Dorsal setae have a broad pigmented convex dorsum, and on their under side a prominent keel, dorsal setae with many short broad dagger-shaped ciliations, and are 35–60 $\mu$  long. Some of the dorsal setae are unpigmented, but these areas are not conspicuous (unlike the prominent white spots of *E. guttatus*, n. sp.). The crista has a broad shield which carries the normal dorsal setae. Sensillary setae to crista robust, tapering, with very fine adpressed ciliations, anterior 155 $\mu$  long, posterior 170 $\mu$  long.

*Egg* (laid by adults from Glen Osmond, South Australia). Fig. 11, D–G: Red. Smooth when first laid. Spheroidal, 300 $\mu$  long by 240 $\mu$  wide. Chorion never pigments deeply. Several weeks after the eggs are laid the chorion becomes ridged, and later the deutovum stage appears.

*Description of Larva* (from egg laid by adult which was taken at Glen Osmond). Fig. 9, A–F: Red. Body ovoid, 230 $\mu$  long by 195 $\mu$  wide (unfed; a fully-fed animal measured 920 $\mu$  long by 625 $\mu$  wide). Dorsal scutum nearly circular, except for its concave anterior border, 102 $\mu$  long by 119 $\mu$  wide; with 2 pairs of very faintly ciliated sensillary setae, anterior 66 $\mu$  long, posterior 74 $\mu$ ; with 3 pairs of blunted ciliated non-

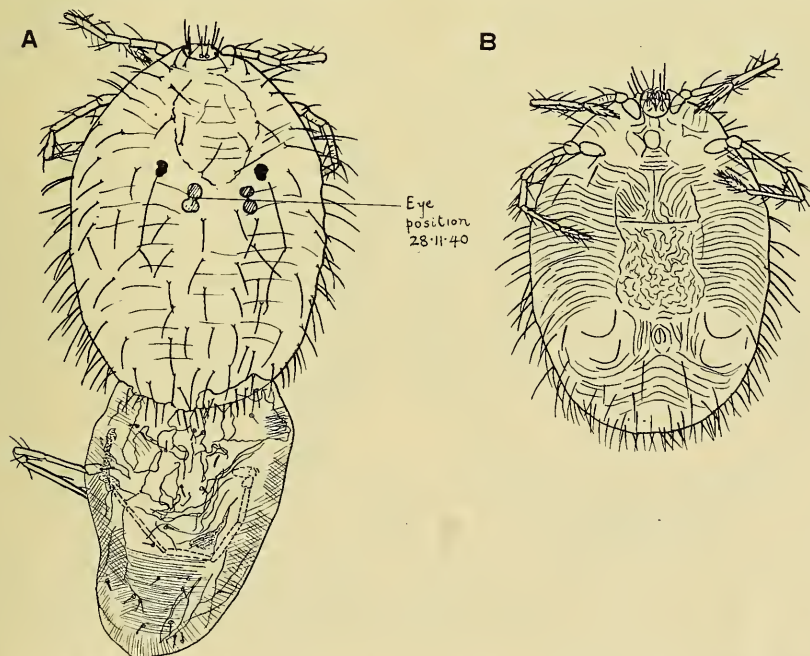


Fig. 10.—*Erythraeus reginae* (Hirst 1928). Post-larval pupa (pupa I), with cast larval skin still attached. A, Dorsal view, transmitted light; B, Ventral view, reflected light. (The figures are taken from ACA 713AO on 24.xi.40; the position of the developing eyes on 28.xi.40 is marked in; they were in the same position on 1.xii.40.)

sensillary setae, arising as figured, anterior  $91\mu$  long, middle  $79\mu$ , posterior 2 stouter than the other 4,  $54\mu$  long. Eyes 2+2, anterior eye the larger. Dorsum with 32 stout blunted ciliated setae,  $35-45\mu$  long, arranged 6, 4, 6, 4, 2, 6, 4; distally on each seta the ciliations are broad and dagger-shaped, proximally they are sharper; the ciliations overlap like the bracts of a pine cone. Venter: between coxae I are 2 slender simple pointed setae  $54\mu$  long; between coxae II and III a pair of pointed ciliated setae  $39\mu$  long; behind coxae III a curved row of 4 ciliated setae,  $37\mu$  long, the medial 2 are pointed, the lateral 2 stronger, blunt; then 2 rows of 4 blunted ciliated setae,  $30-34\mu$  long. Each coxa with one seta: on I pointed, with adpressed ciliations,  $84\mu$  long; on II blunt, with adpressed ciliations,  $36\mu$  long; on III similar,  $36\mu$  long. Legs long and thin: I  $955\mu$  long, II  $845\mu$ , III  $1005\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $150\mu$  long by  $26\mu$  high. Ventral tarsal setae ciliated, dorsal setae simple. Tarsal empodium strong and falciform, with longitudinal ridges along its sides, and with a few faint ventral ciliations, and over-reaches the two lateral claws; anterior claw straight except for a weak terminal hook, with many branching ventral and some short dorsal ciliations; posterior claw retroflexed, with branching ventral ciliations. Metatarsus I  $262\mu$  long. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively. Palpal claw with a strong dorsal tooth. Palpal tarsus as figured.

*Description of Post-Larval Pupa (Pupa I)* (Specimen ACA 713AO). Fig. 10, A, B: Red. Length  $1025\mu$ , width  $705\mu$ . Ovoid, convex dorsally, flattened ventrally, with the normal protuberances which contain the developing tarsi of the nymph. Ventrally there is the normal central recessed area. Pupa patterned with fine ridges as figured. Setae tapering, pointed, with fine adpressed ciliations, to  $145\mu$  long.

*Description of Nymph* (from bred specimens ACA 713AO and ACA 713AP). Figs. 7, I, J; 11, A: Red. Body oval; size (freshly emerged)  $895\mu$  long, by  $640\mu$  wide. Crista, sensillary setae, eyes as in adult (although the nasus is blunter). Anterior sensillary setae  $108\mu$  long, posterior  $142\mu$ . Distance between centres of anterior and posterior sensillae  $375\mu$ . Dorsal setae as figured, elongate, very little expanded, pigmented, with serrations dorsally, keeled ventrally,  $32-45\mu$  long, bearing little resemblance to the adult dorsal setae. Palp similar to adult. Palpal claw ventrally with fine basal teeth. Legs: I  $2300\mu$  long, II  $1350\mu$ , III  $1680\mu$ , IV  $2750\mu$  (including coxae and claws). Tarsus I  $255\mu$  long by  $96\mu$  high; metatarsus I  $505\mu$  long.

When fully-fed ACA 713AO measured 2.06 mm. long by 1.28 mm. wide.

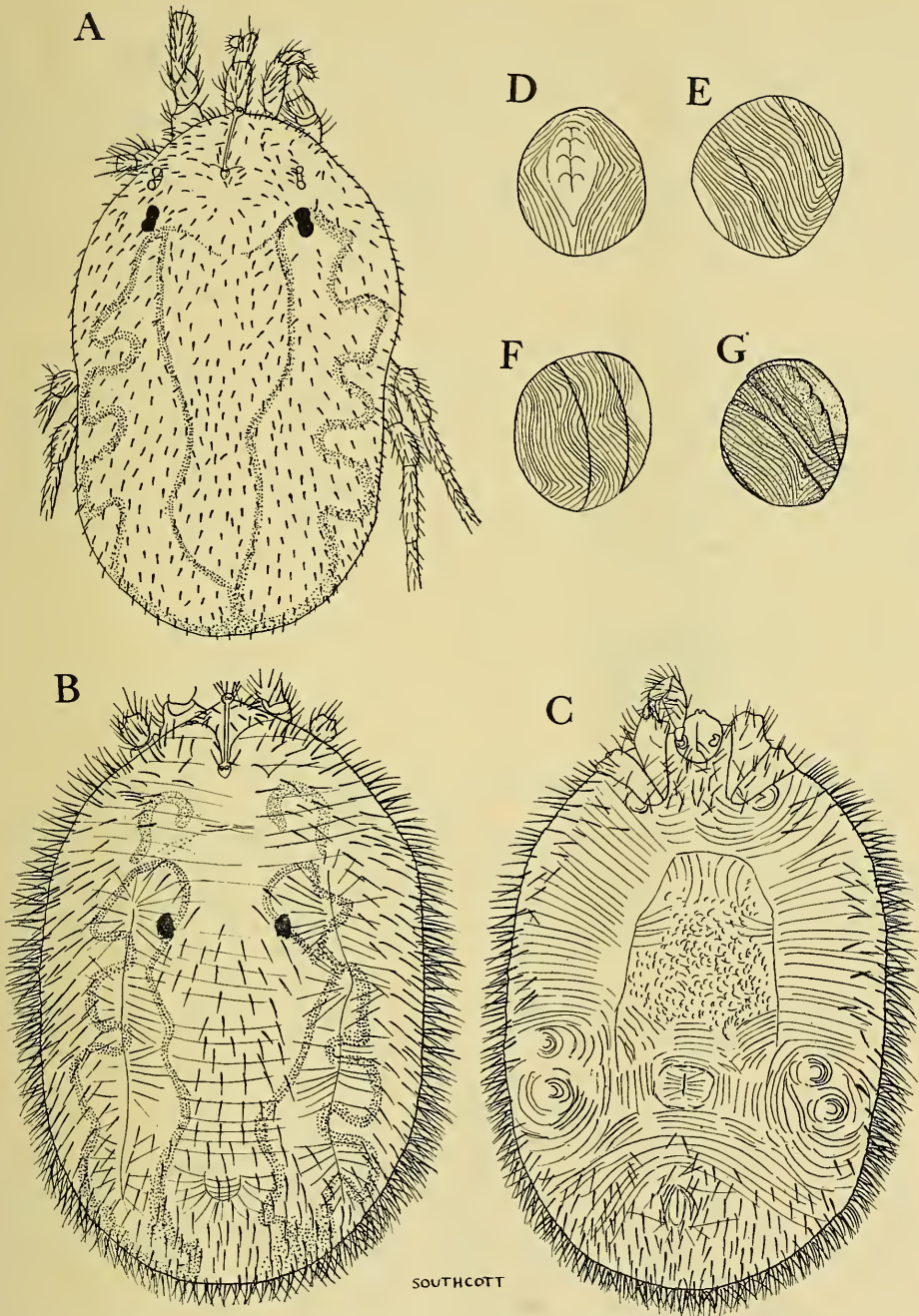
*Description of Pupa II* (ACA 713AO). Fig. 11, B, C: Red, aloid, similar to Pupa I, but larger and with more setae. Length  $2200\mu$ , width  $1450\mu$ . Setae stout, tapering, pointed, with fine adpressed ciliations, each seta arising from a papilla; setae  $60-145\mu$  long. (The adult that hatched out from this Pupa II was  $1900\mu$  long by  $1490\mu$  wide.

*Localities* (larvae only): South Australia: Cape du Couëdic, Kangaroo Island, one specimen, on a psocid, 4th Dec., 1934 (H. Womersley); Flinders Chase, Kangaroo Island, one specimen on a larval homopteron, Dec., 1934 (H.W.); Glen Osmond, 27th Nov., 1936 (1 specimen), 30th Oct., 1937 (1 specimen), on a larval jassid, 2nd Nov., 1941 (1 specimen, free) (all R.V.S.); see also the records of the specimens reared (below).

### *Biology.*

At Glen Osmond, and elsewhere around Adelaide, adults are found from November to March (R.V.S. 1934-1940); the eggs are laid in December-March, and hatch in the following September-November, mostly November (eggs laid on two occasions by adults under observation, and also eggs taken in the field, have hatched to larvae). The eggs are laid in large batches, loosely aggregated. Experimentally the deutovum stage has been seen in early October, for eggs hatching from 10th to 18th Nov., 1938. (Experimentally the larvae will attach to the psocopteron *Troctes divinatorius*, but they are not found on this host in the field.)

Results of successful rearing experiments with batches of larvae hatching from eggs taken in the field at Glen Osmond some months before are set out in the following table. Batches of 5-8 larvae were generally used. Three experiments were successful



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Fig. 11.—*Erythraeus reginae* (Hirst 1928). A, Fully-fed nymph, dorsal view (ACA 713AO); B, C, Post-nymphal pupa (pupa II) (ACA 713AO), with some of the cast nymphal skin still attached; B, Dorsal; C, Ventral; D-G, Eggs, deutovum stage.

in rearing nymphs, and one of these was reared through to an adult. One of each of the batches recorded in the table was reared, although nearly all larvae attached, often more than once:

| Batch Number.              | ACA 713AO.   | ACA 713AP.  | ACA 713AR.                       |
|----------------------------|--|---|----------------------------------|
| Started with . . . .       | 5 larvae 30.x.40.  | 5 larvae 30.x.40.   | 8 larvae 5.xi.40.                |
| Attached finally to jassid | 6.xi.40.   | 5.xi.40.  | Attached and reattached.         |
| Finally detached . . . .   | One left alive on 16.xi.40, removed artificially after the jassid died.          | One larva left alive on 10.xi.40, now detached, jassid still alive. | One larva alive on 14.xi.40.     |
| Larva immobile . . . .     | 18.xi.40 (2).†   | 13.xi.40 (3).   | 18.xi.40 (2).                    |
| Pupa I . . . . .           | 20.xi.40 (12).<br>Length, 1,025 $\mu$ .*<br>Width, 705 $\mu$ .                   | 16.xi.40 (13).  | 20.xi.40 (12).                   |
| Nymph emerged . . . .      | 2.xii.40 (21).<br>Length, 810 $\mu$ .<br>Width, 640 $\mu$ .                      | 29.xi.40 (—).<br>Killed at once.                                    | 2.xii.40 (—).<br>Killed at once. |
| Nymph became immobile      | 21.xii.40.<br>Length, 2,060 $\mu$ .*<br>Width, 1,280 $\mu$ .                     | —   | —                                |
| Pupa II . . . . .          | 23.xii.40 (15).<br>Length, 2,200 $\mu$ .*<br>Width, 1,450 $\mu$ .                | —   | —                                |
| Adult emerged . . . .      | 7.i.41 ♀.<br>Length, 1,900 $\mu$ .<br>Width, 1,490 $\mu$ .<br>(Died on 16.i.41.) | —   | —                                |

\* Stage figured in this paper.

† The figures in brackets indicate the total time in days spent in that stage.

The above experiments may be summarized as follows: When fully-fed, the larva remains in an immobile state for 2–3 days, then pupates; the pupa I stage lasts 12–13 days; the nymphal stage lasts 21 days. The adult lives for several weeks at least.

*Remarks:* The only stage of this species known previously was the adult, the larval and all the other stages of the life-history recorded above being previously completely unknown.

For remarks on the systematic position of *E. reginae*, see under *E. antepodianus* (Hirst 1928), to follow.

#### ERYTHRAEUS ANTEPODIANUS (Hirst 1928).

*Leptus antepodianus* Hirst 1928, *Ann. Mag. nat. Hist.* (10) 1(4): 570.

*Erythraeus reginae* Womersley 1934 (part), *Rec. S. Aust. Mus.*, 5(2): 219.

The type locality of this species was Tanunda, South Australia (recorded as "Tununda" by Hirst). It is very close to the preceding species, with which it was synonymized by Womersley. I have had the opportunity of examining the type of *E. antepodianus* and the co-types (♂ and ♀) of *E. reginae* in the South Australian Museum, and agree with Hirst's action in making of this a distinct species.

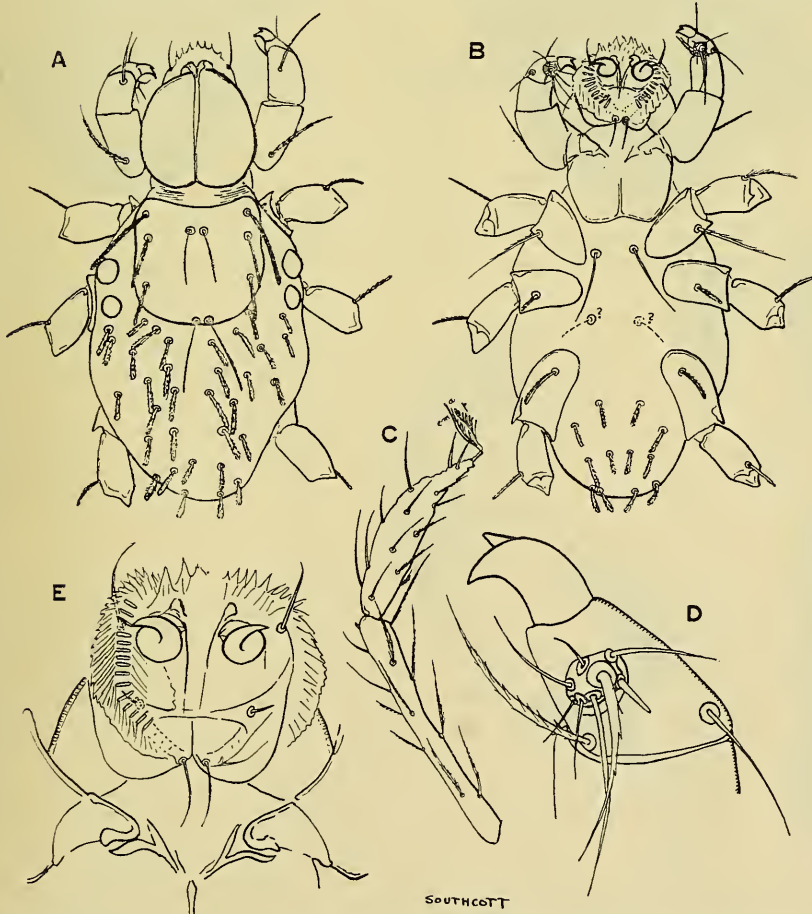
A larval species quite close to the larva of *Erythraeus reginae*, *Erythraeus stuarti*, n. sp., described later in this paper, has been found at Attack Creek, in the Northern Territory. At Tennant Creek, about 40 miles south, an adult almost indistinguishable from *E. reginae* has been found, and this is quite likely the adult of *Erythraeus stuarti*, n. sp. There are minute differences in the structure of the dorsal setae between this adult (which is not described in this paper) and *E. reginae*, and there are also comparable minute differences in *E. antepodianus*. Other somewhat similar adults from eastern Australia show other minute differences in the dorsal setae. It has not been possible to work out the taxonomy of this complex group in this paper, and in fact it may have

to wait until the larvae are known. The separation (later in this paper) of *Erythraeus guttatus*, n. sp., which is related to this complex but can be separated easily, is a further indication of the complexity of the group. The most promising differences upon which the further species of adults can be separated out appear to be the minute structure of the dorsal setae and the arrangement of the dorsal patches of unpigmented setae.

The separation of *E. antepodianus* from *E. reginae* was not attempted in the key. Hirst distinguished them thus: (*E. antepodianus*) . . . "body setae . . . not shaped like those of *L. reginae*, having the distal part narrower, more drawn out, and sharply pointed. Terminal claw of penultimate segment of palp poorly developed, being weaker than that of *L. reginae*. Palpal tarsus club-shaped and swollen, being much stouter than that of *L. reginae*".

ERYTHRAEUS STUARTI, n. sp. Fig. 12, A-E.

*Description of Larva (Type)*: Red. Ovoid. Body  $240\mu$  long by  $165\mu$  wide. Dorsal scutum squarish, concave anteriorly, sides straight, slightly concave between middle and posterior non-sensillary setae; scutum  $96\mu$  long by  $102\mu$  wide. Sensillary setae of scutum expand very slightly, are ciliated, anterior  $39\mu$  long, posterior  $54\mu$ . Non-sensillary setae of scutum are strongly ciliated, anterolateral  $56\mu$  long, middle  $43\mu$ , posterolateral (which resemble the normal dorsal setae)  $30\mu$ . Eyes 2+2. Dorsal setae 32, short, somewhat expanded, feather-shaped, with fine pointed ciliations, setae 24-34 $\mu$  long, arranged 4, 4, 4, 6, 4, 4, 5, 2. Venter: between coxae I a pair of long simple tapering pointed setae,

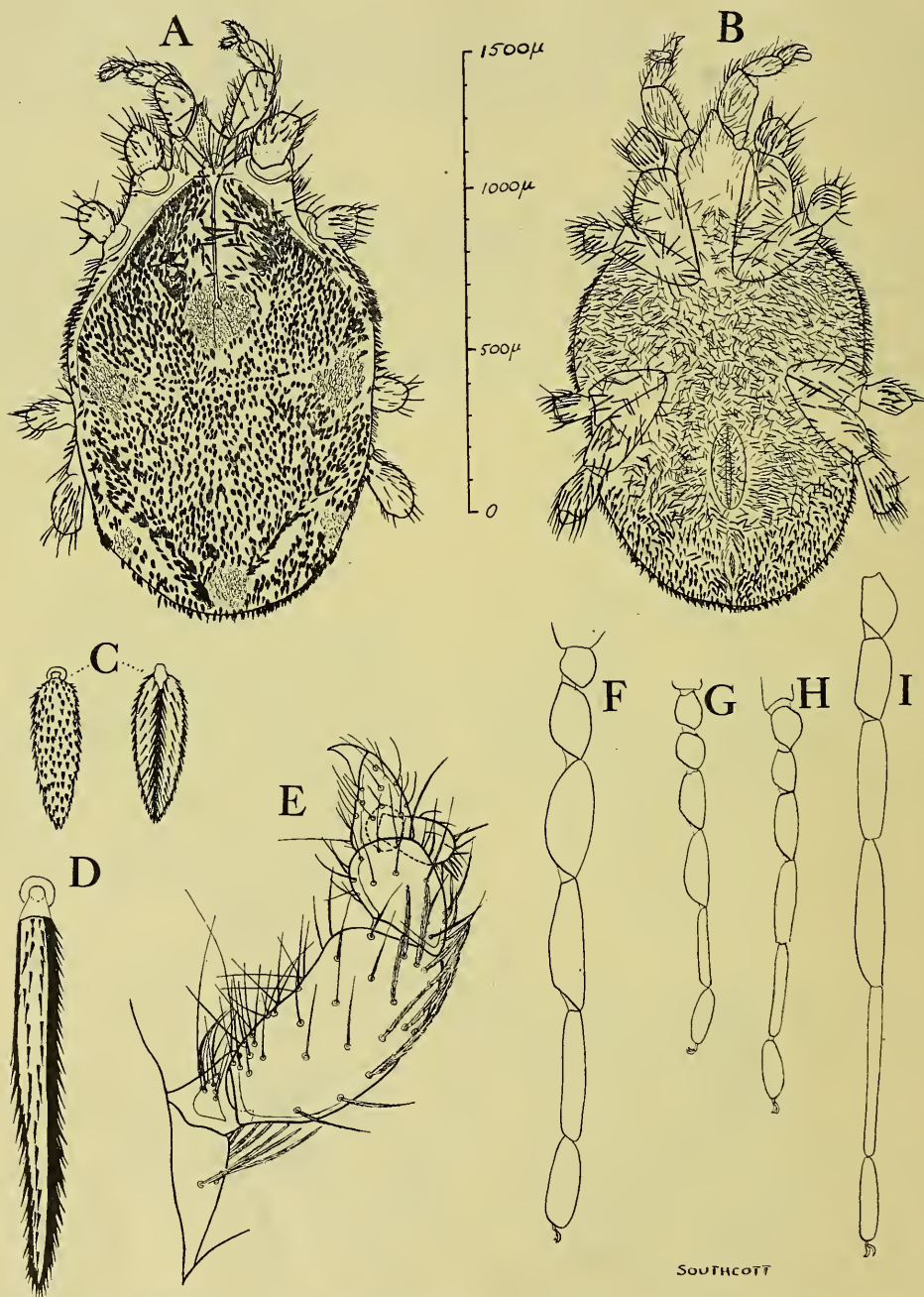


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Fig. 12.—*Erythraeus stuarti*, n. sp. Larva. A, dorsum; B, Venter; C, Tarsus I and metatarsus I; D, Tip of palp; F, Mouth-parts from below. (All figures from the type.)



$40\mu$  long; pair between coxae II and III are obscured in the type; behind coxae are 3 rows of setae, 4, 4, 4, similar to the dorsal setae. Seta on coxa I long, pointed, ciliated,  $68\mu$  long; on II short, blunt, ciliated,  $14\mu$ ; on III blunt, ciliated,  $24\mu$  long. Legs: I  $640\mu$  long, II  $545\mu$ , III  $710\mu$  (including coxae and claws). Tarsus I  $105\mu$  long by  $22\mu$  high; dorsal setae of tarsus simple, ventral setae ciliated. Tarsal empodium and claws weak



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Fig. 13.—*Erythraeus guttatus*. n. sp. A, Dorsum; B, Venter; C, Dorsal seta  $34\mu$  long, from above and below; D, Longer dorsal seta,  $79\mu$ , from near crista; E, Palp; F, G, H, I, Outline of legs, I, II, III, IV (Figs. A, B, F-I all to scale given; all figures from the type.)

(see figure). Metatarsus I  $146\mu$  long. Capitulum as figured. Palpal claw bifurcate. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively.

*Locality*: Type larva from Attack Creek, Northern Territory, running free over the ground, 23rd June, 1942 (R.V.S.); in author's collection (ACA 1028).

*Remarks*: Close to *E. reginae* (Hirst 1928) larva. See remarks under *Erythraeus antepodianus*.

ERYTHRAEUS GUTTATUS, n. sp. Fig. 13, A-I.

*Description of Adult (Type)*: Reddish, dorsally overlaid with black setae, and dorsally also with some prominent white spots. Body  $1330\mu$  long by  $870\mu$  wide. Crista normal; anterior sensillary area enlarged, bulbous, carrying 10 heavily ciliated long pigmented setae,  $50-146\mu$  long, as well as the 2 sensillary setae. Sensillary setae to crista pointed, with adpressed ciliations, anterior  $101\mu$  long, posterior  $104\mu$ . Crista surrounded by a broad shield. Eyes  $2+2$ , on distinct shields, behind middle of crista. Most dorsal setae expanded, leaf-like, heavily pigmented, with many short serrations and a ventral ciliated keel, dorsal setae  $26-34\mu$  long by  $8-10\mu$  wide, some posterior setae longer, to  $57\mu$ ; over the anterior part of the dorsum the setae are stronger, mostly to  $47\mu$  long, but a few are much longer (Fig. 13, D), to  $80\mu$ . The conspicuous white spots on the dorsum are due to similar setae,  $40-73\mu$  long, but entirely unpigmented. The largest white patch surrounds the posterior sensillary area; there are 2 large white patches laterally, half-way along the body; another smaller one median in position, at the posterior end of the dorsum; 2 smaller still, posterolateral on dorsum, of only about 10 setae; a further middle median patch may be present midway between the antero-median and posteromedian patches (if present, it is of only 1-2 setae; absent from type). Dorsal setae encroach on the ventral surface of the body posteriorly, as far forward as the anus; otherwise venter with normal ciliated blunted setae. Legs long and thin: I  $2070\mu$  long, II  $1400\mu$ , III  $1490\mu$ , IV  $2380\mu$  (all including coxae and claws). Legs thickly covered with setae; on the distal half of tibia I and the distal  $\frac{1}{3}$  of tibia IV the setae are unpigmented, giving prominent white bands; otherwise setae black (except for the numerous fine sensory spines of the legs). Tarsus I  $280\mu$  long by  $100\mu$  high. Tarsal claws 2, strong, covered with fine ciliations. Metatarsus I  $360\mu$  long. Tarsus IV  $260\mu$  long by  $50\mu$  high. Metatarsus IV  $515\mu$  long. Palp as figured, claw ventrally with fine basal teeth.

*Locality*: Glen Osmond, South Australia. Adults are found from late November to mid-January, in leaf and bark debris at the bases of eucalypts (from 1936 to 1940; R.V.S.). Type taken on 1st Dec., 1937; in author's collection.

*Remarks*: This species comes within a complex which includes also *E. reginae*, *E. antepodianus* and *E. stuarti*, n. sp. (larval), etc. See remarks for *E. antepodianus*.

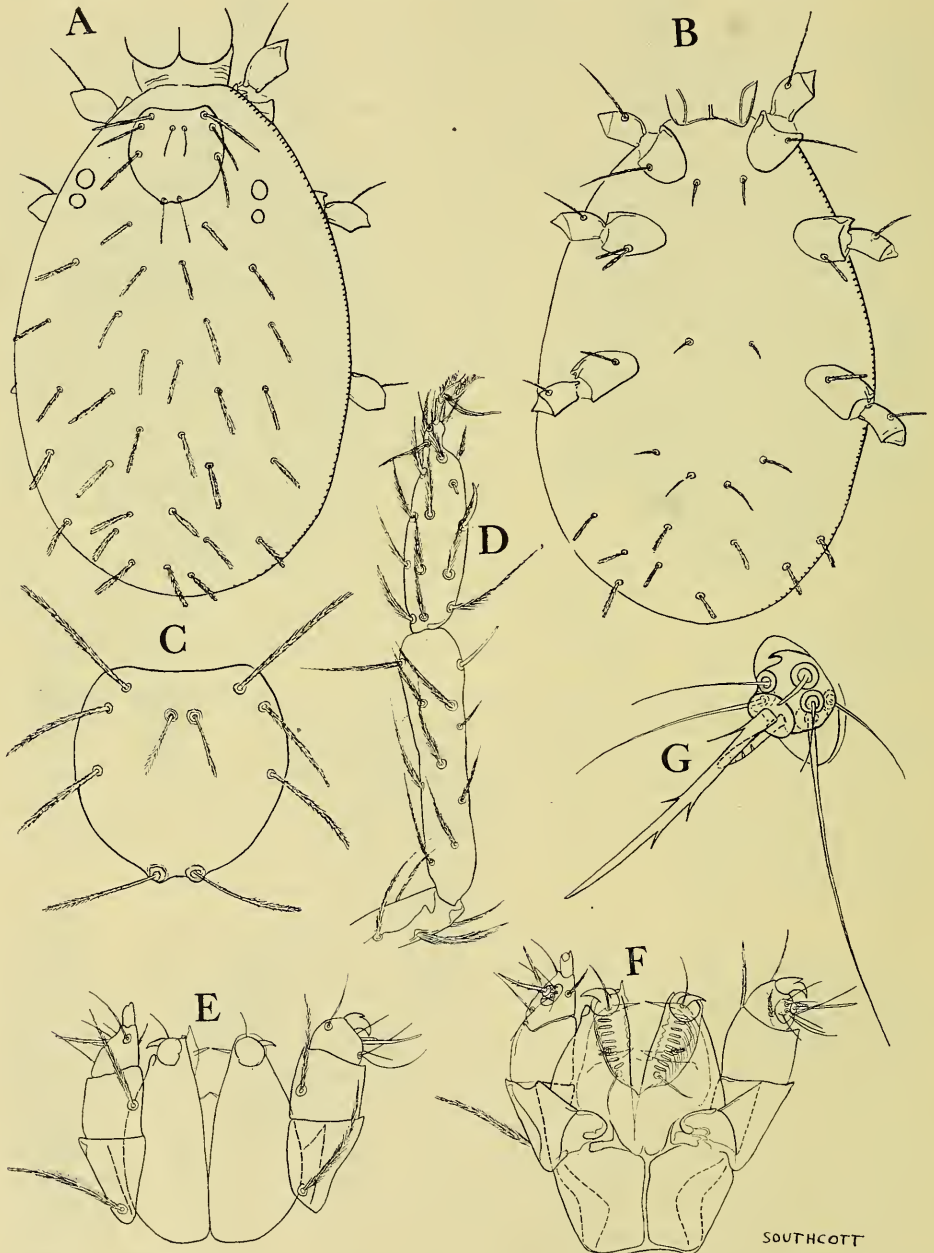
For the relationship of this species to *Erythraeus osmondensis*, n. sp. (larval), see remarks for that species.

One specimen laid eggs in mid-January, 1940, which did not hatch.

ERYTHRAEUS OSMONDENSIS, n. sp. Figs. 14, A-G; 15, A-D.

*Description of Larva* (from the two co-types). Fig. 14, A-G: Red. Body ovoid,  $270\mu$  long by  $180\mu$  wide. Dorsal scutum elongate-oval with the anterior margin concave; anterolateral angles rounded; scutum  $81\mu$  long,  $79\mu$  wide. Scutum with 2 pairs of ciliated sensillary setae, anterior  $24\mu$  long, posterior  $47\mu$ ; with 3 pairs of ciliated blunted non-sensillary setae, anterior  $62\mu$  long, middle  $46\mu$ , posterior  $46\mu$ . Eyes  $2+2$ . Dorsum with about 32 setae, blunted, slightly tapering, strongly ciliated,  $37-44\mu$  long, arranged 4, 4, 4, 6, 5, 6, 3; the ciliations proximally placed on the setae are tapering and acute, distally they are blunted. Venter: between coxae I 2 pointed very slightly ciliated setae,  $28\mu$  long; between coxae II and III a similar pair  $32\mu$  long; behind coxae III are 3 rows of 4 setae, the first 4 tapering, ciliated, somewhat blunted, in a line convex posteriorly,  $28-30\mu$  long, the other 2 rows of stouter setae, similar to dorsal setae,  $29-30\mu$  long. Seta on coxa I long, tapering, pointed, ciliated,  $68\mu$  long; on II shorter, blunted, ciliated,  $44\mu$ ; on III similar,  $30\mu$ . Legs: I  $488\mu$  long, II  $464\mu$ ; III  $532\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $83\mu$  long by  $22\mu$  high, all of its setae

ciliated except a dorsal rod (the tarsus has also a small retroflected dorsolateral peg). Tarsal empodium falciform, over-reaching the claws, and with a few dorsal and ventral ciliations; anterior claw of tarsus slightly curved, with a weak terminal hook, and many branching ventral ciliations; posterior claw curved sinuously, with distal end retroflected, and with a few dorsal and many branching ventral ciliations. Metatarsus I  $106\mu$  long. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively. Palpal claw with a strong dorsal tooth. Palpal tarsus as figured.



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Fig. 14.—*Erythraeus osmondensis*, n. sp. Larva. A, Dorsum; B, Venter; C, Dorsal scutum; D, Tarsus I and metatarsus I; E, Capitulum from above (slightly distorted); F, Same from below; G, Palpal tarsus. (All figures from the co-types.)

*Description of Post-Larval Pupa (Pupa I) (from ACA 1009).* Fig. 15, A, B: Red. Ovoid, flattened ventrally. Length  $650\mu$ , width  $445\mu$ . Dorsal setae lanceolate, with fine serrations, to  $90\mu$  long.

*Description of Nymph (from ACA 1009).* Fig. 15, C, D: Red, except for the white markings on the legs. Body length  $520\mu$ , width  $370\mu$  (unfed). Crista normal; sensillary setae slender, tapering, with fine adpressed ciliations, anterior  $91\mu$  long, posterior  $112\mu$ . Eyes  $2+2$ . Dorsal setae heavily pigmented, somewhat leaf-like, with rows of flattened ciliations, keeled ventrally,  $35-66\mu$  long. Some of the longer setae are present alongside the crista. None of the dorsal setae unpigmented. Palp normal, tibial claw ventrally with fine basal teeth. Legs: I  $1410\mu$  long, II  $925\mu$ , III  $1000\mu$ , IV  $1730\mu$  (all including coxae and claws). There are a few unpigmented setae distally on the dorsal side of tibia I; the setae on the distal  $\frac{1}{3}$  of tibia IV are unpigmented. Tarsus I  $169\mu$  long by  $63\mu$  high. Metatarsus I  $283\mu$  long. Tarsus IV  $167\mu$  by  $36\mu$ . Metatarsus IV  $400\mu$  long.

*Localities:* Mt. Osmond, South Australia, one larva, 1st Sept., 1933 (recorded by Womersley; slide labelled "1.10.33"), co-type; second co-type, one larva from Glen Osmond, 9th Nov., 1941, attached to a thrips (ACA 1010; R.V.S.); a further larva,

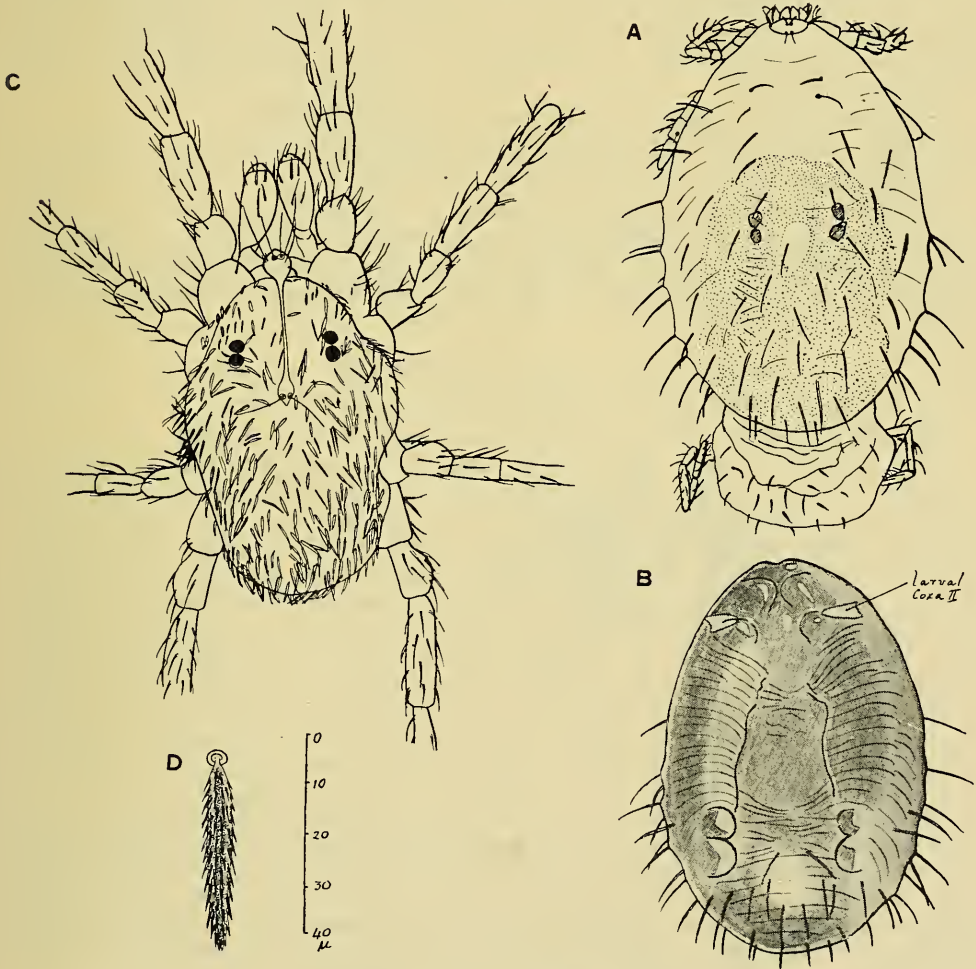


Fig. 15.—*Erythraeus osmondensis*, n. sp. A, B, Post-nymphal pupa (pupa II); A, Dorsal view, transmitted light, showing developing nymph, and with the cast larval skin still attached; B, Ventral view, reflected light; C, D, Nymph; C, Dorsal aspect; D, Dorsal seta, to scale shown. (All figures from ACA 1009; see text.)

attached to a thrips at Glen Osmond, 9th Nov., 1941, was reared to a nymph (specimen ACA 1009; see under biology).

*Biology.*

Specimen ACA 1009 when taken (9th Nov., 1941) had body  $290\mu$  long by  $165\mu$  wide (measured while still attached to the thrips). The thrips was kept alive on grass in a tube, and the mite remained attached until 16th Nov., 1941, when the thrips died. The mite left the host some hours later and wandered around the tube. Fresh jassids and thrips were given, but the mite did not attach to any. It became immobile on 17th Nov., 1941, and underwent ecdysis to pupa I on 19th Nov., 1941. The nymph emerged on 28th Nov., 1941, i.e., pupa I stage lasted 9 days. Food was provided for the nymph, but it died on 9th Dec., 1941, the body length then being  $575\mu$ , and width  $485\mu$ .

Specimen ACA 1010 was partly fed when captured, body length  $430\mu$ , width  $270\mu$ . It was dislodged on 9th Nov., 1941, and although fresh jassids and thrips were given, did not attach, and died on 24th or 25th Nov., 1941.

*Remarks:* The author considers it almost certain that *E. osmondensis*, n. sp. is the larva of *E. guttatus*, n. sp. There are strong resemblances between the nymph obtained and the adult *E. guttatus*; a method of elimination in considering the known adults and larvae at the base of this specimen of *Eucalyptus rostrata* lends very strong support to this belief. Until the relationship is proved, however, the larva is best considered separately.

Presumably thrips are the normal hosts of this larval species.

Minor teratological variations are encountered with this larva, particularly a doubling or forking of the seta on coxa I.

The first co-type was among the syntypes of *Bockartia longipes* Womersley 1934, but was not used in the original description and figures of that species (which is the larva of *Erythraeus urbrae* Wom. 1934). The first co-type (damaged), from Mt. Osmond, in the South Australian Museum; the other specimens, including the second co-type, in author's collection.

ERYTHRAEUS PILOSUS (Hirst 1928). Figs. 16, A-F; 17, A-C.

*Leptus pilosus* Hirst 1928, *Ann. Mag. nat. Hist.*, (10) 1(4): 569.

*Erythraeus pilosus* Womersley 1934, *Rec. S. Aust. Mus.*, 5(2): 220.

*Description of Larva.* Fig. 16, A-F: Red. Body ovoid,  $250\mu$  long by  $190\mu$  wide (unfed). Dorsal scutum oval, flattened anteriorly,  $83\mu$  long by  $110\mu$  wide; with 2 pairs of simple slender sensillary setae, anterior  $94\mu$  long, posterior  $68\mu$ ; with 3 pairs of non-sensillary setae, anterior pair tapering, pointed, with adpressed ciliations,  $79\mu$  long, middle pair blunt, ciliated,  $60\mu$  long, posterior pair similar,  $48\mu$  long. Eyes 2+2, anterior the larger. Dorsum with about 29 setae, thin, tapering only slightly distally, blunted, and with slender pointed ciliations,  $31-45\mu$  long, arranged 4, 4, 4, 4, 6, 4, 3. Venter: between coxae I are 2 simple spiniform setae  $47\mu$  long; between coxae II and III are 2 similar setae,  $36\mu$  long; behind coxae III a transverse row of 4 spiniform slightly curved setae,  $28-38\mu$  long, then 4 blunted curved setae with fine adpressed ciliations,  $28-36\mu$  long, then 3 setae similar to the dorsal setae,  $20-28\mu$  long. Seta on coxa I long, spiniform,  $62\mu$ ; on II short, blunt, with adpressed ciliations,  $27\mu$  long; on III similar,  $29\mu$  long. Legs long, thin: I  $572\mu$  long. II  $517\mu$ , III  $662\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $94\mu$  long by  $21\mu$  high; none of tarsal setae ciliated; tarsal empodium strong, falciform, longitudinally ridged; anterior claw almost straight, with a weak terminal hook, and with many branching ventral ciliations reaching beyond the claw; posterior claw retroflexed, with branching ventral ciliations. Metatarsus I  $145\mu$  long. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively. Palpal claw with a strong dorsal tooth. Palpal tarsus as figured.

*Description of Post-Larval Pupa (Pupa I)* (from ACA 863). Fig. 17, A-C: Red. Shape ovoid, flattened ventrally. Body length  $720\mu$ , width  $485\mu$ . Setae lanceolate, with fine ciliations.

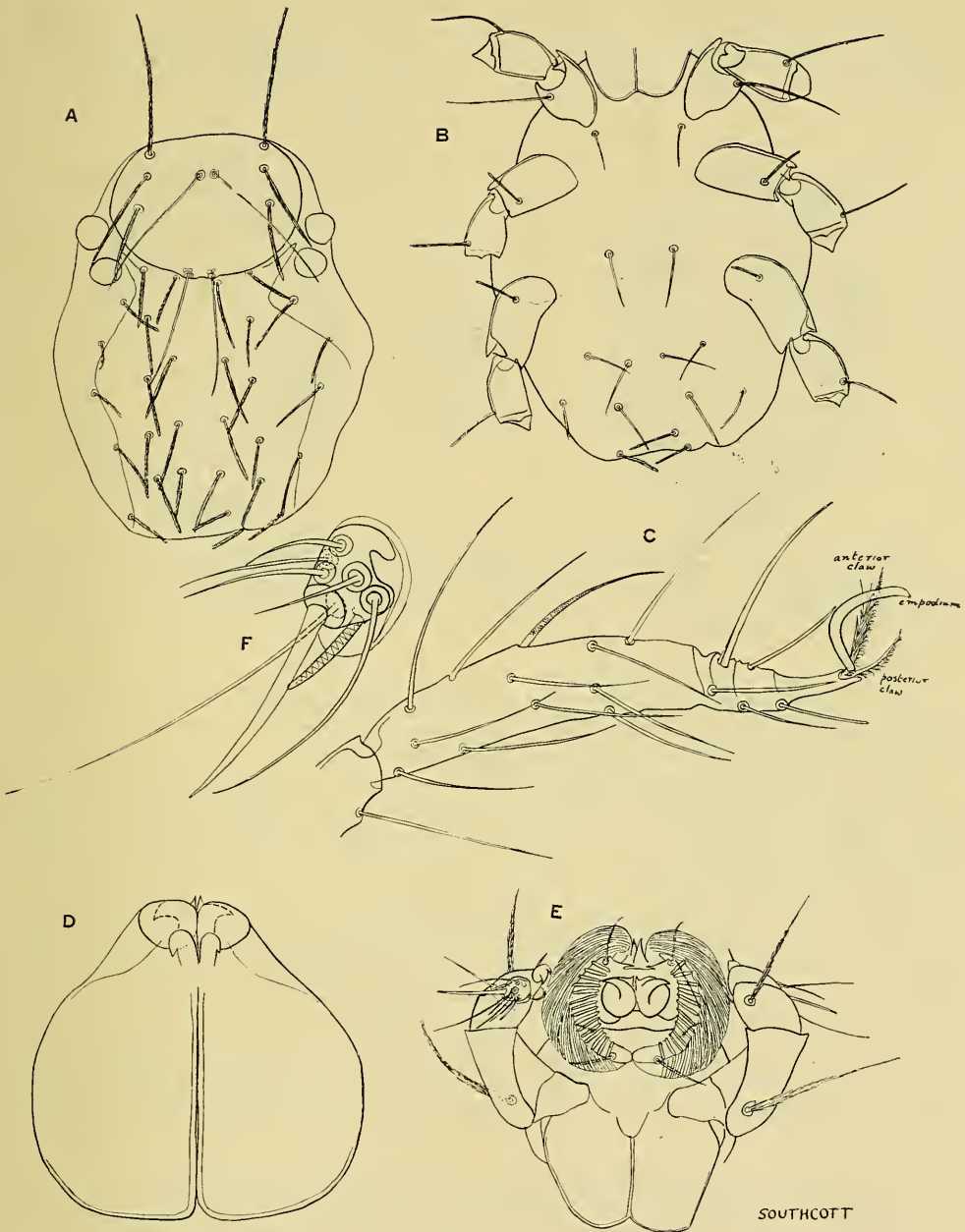


Fig. 16.—*Erythraeus pilosus* (Hirst 1928). Larva. A, Dorsum; B, Venter; C, Tarsus I; D, Capitulum, less palpi, from above; E, Capitulum from below (with dorsal view of palp on right); F, Palpal tarsus.

*Description of Nymph* (ACA 863, freshly emerged): Red. Body length  $510\mu$ , width  $280\mu$ . Distance between centres of anterior and posterior sensillae  $138\mu$ . Sensillary setae slender, anterior  $145\mu$  long, posterior  $170\mu$ . Dorsal setae long, fine, ciliated, pointed acutely (similar to adult),  $45\text{--}140\mu$  long. Legs long, with very long setae (legs of this specimen too crumpled for measuring). Tarsus I  $180\mu$  long by  $56\mu$  high; metatarsus I  $330\mu$  long.

*Localities* (larvae only): Glen Osmond, South Australia, 11th Mar., 1936, one specimen, free (R.V.S.), and several more at Glen Osmond in Nov., 1940, and Oct., 1941, attached to Psocoptera (*Myopsocus* sp.) and small Heteroptera, among débris at eucalypt bases (including ACA 863, below). For bred larvae see under biology.

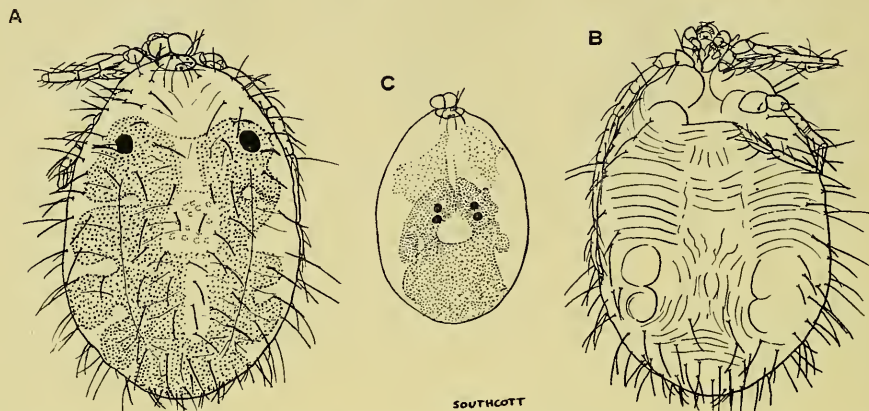


Fig. 17.—*Erythraeus pilosus* (Hirst 1928). Post-larval pupa (pupa I). A, above, containing developing nymph, and with the cast larval skin still attached (ACA 863 on 27.xi.40); B. Below, by reflected light; C, Dorsal view on 1.xii.40 to show further development of nymph. (All figures from ACA 863; see text.)

#### *Biology.*

The adults are found at Glen Osmond, South Australia, from January to August, but mainly in the autumn. The larvae occur from November to March, and the nymphs from April to May (in the field, but see ACA 863 below).

Three adults were taken at Glen Osmond on 8th May, 1938. Eggs were laid by next day; they were kept in a saturated atmosphere. By 21st Nov., 1938, one larva had hatched, and another by 27th Nov., 1938. Further larvae continued to hatch during December. (The eggs are similar to those of *E. reginae*, but the chorion is much more deeply pigmented.)

Larval specimen ACA 863 was taken at Glen Osmond on 16th Nov., 1940, attached to *Myopsocus* sp. It was still attached on 19th Nov., 1940. On 20th Nov., 1940, the host died and the mite left it, apparently less than full-grown. It was immobile on 21st Nov., 1940, and pupated on 24th to 25th Nov., 1940. The nymph emerged on 5th Dec., 1940. Thus the pupa I stage lasted 11–12 days.

*Remarks:* The type adult was from Dubbo, New South Wales, 7th Aug., 1927, in the South Australian Museum. The only stage of this species that was known previously was the adult; the larva and the other stages described above being completely new.

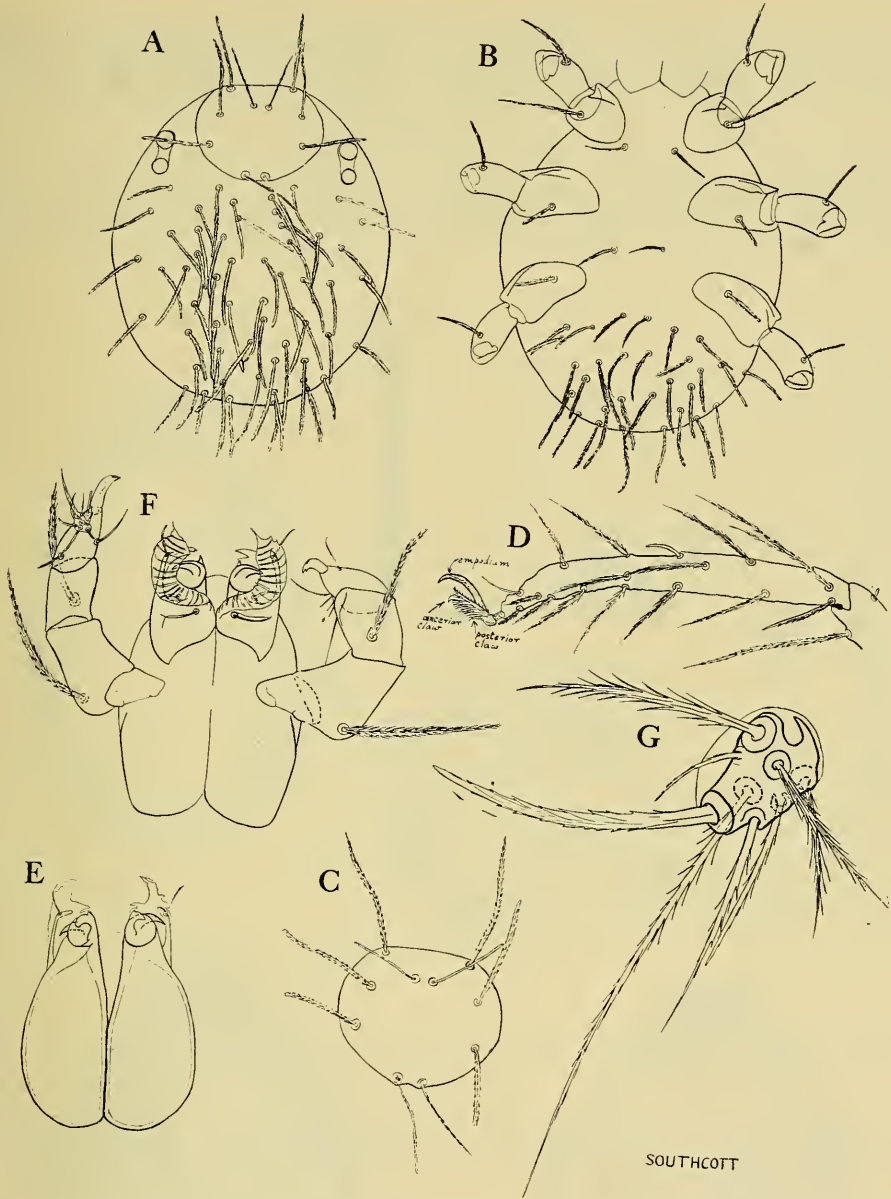
ERYTHRAEUS URBRÆ Womersley 1934. Figs. 18, A–G; 19, A–H.

*Erythraeus urbræ* Womersley 1934, *Rec. S. Aust. Mus.*, 5(2): 221.

*Bockartia ? longipes* Womersley 1934 (larval), *Ibid.*, 5(2): 252.

*Bochartia longipes* Womersley 1936, *J. Linn. Soc. Lond., Zool.*, 40(269): 120.

*Description of Larva* (from the 3 syntypes of *Bockartia ? longipes* Wom.). Fig. 18, A–G: Red. Body ovoid, length  $360\mu$ , width  $290\mu$ . Dorsal scutum oval, flattened anteriorly,  $108\mu$  long by  $136\mu$  wide; with 2 pairs of finely ciliated sensillary setae, anterior  $60\mu$  long, posterior  $73\mu$ ; with 3 pairs of strongly ciliated non-sensillary setae, anterior pair tapering, pointed,  $91\mu$  long, middle 2 somewhat blunted,  $83\mu$  long, posterior 2 are the stoutest, blunted,  $65\mu$  long. Eyes 2+2 on distinct shields; anterior eye the larger. Dorsum with 54 blunted ciliated long strong setae,  $52$ – $81\mu$  long; the ciliations taper and are almost acute. The setae are arranged in obscure lines across the dorsum. Venter: between coxae I a pair of tapering pointed ciliated setae  $44\mu$  long; between coxae II and III a



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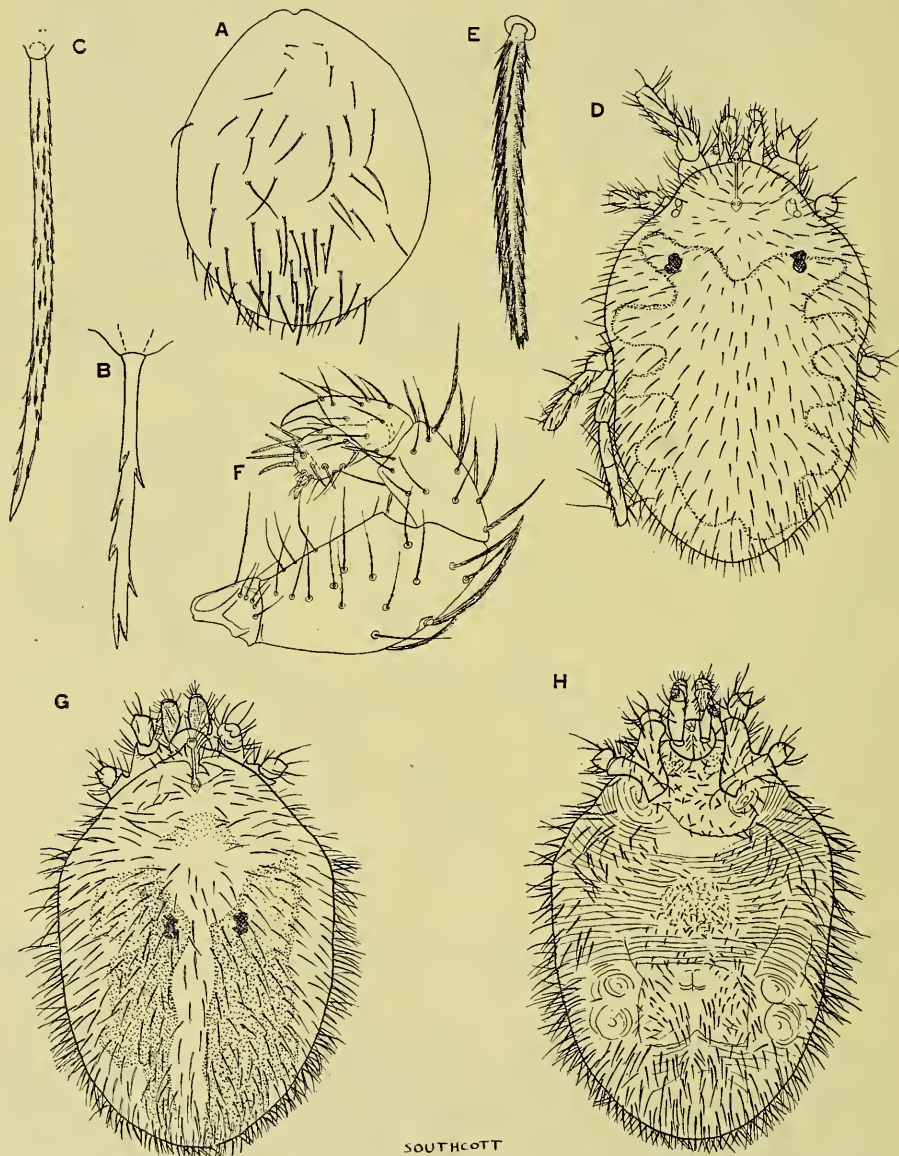
Fig. 18.—*Erythraeus urbrae* Wom. 1934. Larva. A, Dorsum; B, Venter; C, Dorsal scutum; D, Tarsus I; E, Capitulum, less palpi, from above; F, Capitulum from below (with dorsal view of palp on right); G, Palpal tarsus. (All figures from the syntypes of *Bockartia ? longipes* Wom. 1934.)

stronger pair, heavily ciliated, tapering, pointed,  $50\mu$  long; just behind coxae III a row of 9 ciliated tapering setae, the central 2 pointed, other 7 less so,  $41-49\mu$  long; then 3 or 4 obscure rows of setae, 17 in all, tapering, somewhat pointed, ciliated,  $54-64\mu$  long. Each coxa with one seta: on I pointed, with adpressed ciliations,  $104\mu$  long; on II blunted, with adpressed ciliations,  $25\mu$  long; on III blunted and ciliated,  $39\mu$  long. Legs long and thin, I  $1072\mu$  long, II  $974\mu$ , III  $1120\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $171\mu$  long by  $23\mu$  high; empodium strong and falciform, with dorsal and ventral ciliations, and over-reaching the 2 lateral claws; anterior claw with a slightly curved shaft and terminal ventral hook, and with many



dorsal and ventral ciliations; posterior claw retroflexed, with branching ventral ciliations. All setae of the tarsus are ciliated, except one, which is strong, curved, simple, arising at about the middle of the dorsum of the tarsus. Metatarsus I  $293\mu$  long. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively. Palpal claw with a long strong dorsal tooth. Palpal tarsus as figured.

*Description of Post-Larval Pupa (Pupa I).* Fig. 19, A-C: Red. Ovoid, evenly rounded posteriorly, rather pointed anteriorly, and there notched. Length  $750-850\mu$ , width  $570-600\mu$  (several specimens). Dorsum convex, and with setae: 2 rows of 2 setae, slightly tapering, with stout ciliations,  $20-23\mu$  long; then 2 rows of tapering pointed



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Fig. 19.—*Erythraeus urbrae* Wom. 1934.—A-C, Pupa I. A, Dorsal view of specimen  $750\mu$  long by  $600\mu$  wide; B, Dorsal seta  $23\mu$  long; C, Dorsal seta  $112\mu$  long. D-F, Nymph dorsal view, with outline of contained pigment mass (ACA 874 on 28:xii.40); E, Dorsal seta  $66\mu$  long; F, palp. G, H, Pupa II; G, Dorsal view, transmitted light (ACA 874 on 4.i.41); H, Venter of same, reflected light.

setae with adpressed ciliations,  $54\mu$ ,  $85\mu$  long respectively; then a number of rows of similar setae  $80$ – $112\mu$  long (lengths increasing posteriorly over the dorsum); the setae are free from ciliations in their proximal part. Ventral surface almost devoid of setae, except posteriorly, and there the setae are similar to those of the dorsal surface. Each seta of the pupa arises from a definite papilla.

*Description of Nymph* (freshly-emerged, i.e., unfed; description from ACA 19). Fig. 19, D–F: Body red, ovoid,  $600\mu$  long by  $380\mu$  wide. Anterior end of crista enlarged to a spheroidal bulb, wider than long, which carries the 2 sensillary setae, and continues downward and forward as a blunted conical nasus. Length of crista to front of bulb  $344\mu$ ; distance between centres of anterior and posterior sensillae  $308\mu$ . Bulb also carries 6 long ciliated tapering setae,  $100$ – $215\mu$  long. Sensillary setae long, thin, tapering, pointed, finely ciliated; anterior  $150\mu$  long, posterior  $190\mu$ . Eyes 2 + 2, each lateral pair on a distinct shield. Anterior eye level with middle of crista; posterior eye the more lateral. Dorsum thickly covered with dark tapering somewhat blunted ciliated setae,  $49$ – $146\mu$  long. Ventral setae more variable,  $36$ – $145\mu$  long, generally blunted (some anteriorly are pointed), less pigmented than the dorsal setae except at the posterior pole. External genitalia immature. Anus normal, bounded by 2 lateral crescentic laminae,  $56\mu$  long, each carrying 4 normal ventral setae  $30$ – $35\mu$  long. Legs long and thin: I  $2070\mu$  long, II  $1240\mu$ , III  $1420\mu$ , IV  $2200\mu$  (all excluding coxae). Tarsus I  $249\mu$  long by  $96\mu$  high, II  $152\mu \times 60\mu$ , III  $159\mu \times 54\mu$ , IV  $194\mu \times 49\mu$ . Tarsal claws 2, strong, falciform, covered with fine ciliations. Metatarsus I  $478\mu$  long, II  $308\mu$ , III  $390\mu$ , IV  $710\mu$ .

*Description of Post-Nymphal Pupa (Pupa II)* (ACA 864). Fig. 19, G, H: Red. Shape normal for pupae. Length  $1690\mu$ , width  $1120\mu$ . Dorsal setae lanceolate, pointed, finely ciliated, to  $155\mu$  long.

*Adult*: Described by Womersley in 1934. The dorsal setae are variable in length,  $63$ – $250\mu$  long.

*Localities* (larvae only): South Australia: Mt. Osmond, 1st Sept., 1933, the 3 syntypes of *Bockartia ? longipes*, collected by Womersley (slide labelled "1.10.33"); National Park, Belair, 7 specimens, 5th Nov., 1933 (H.W.): Cape du Couedic, Flinders Chase, Kangaroo Island, on a psocid, 1 specimen, 4th Dec., 1934 (H.W.); Glen Osmond, from August to January, but commonest from October to December, in vegetation (mostly *Avena fatua* L.) and on trunks and among foliage of *Eucalyptus rostrata*, etc., mostly running free, but also a considerable number has been taken attached to jassids, Psocoptera (*Myopsocus* sp.), etc., from 1936 to 1940 (R.V.S.); Adelaide, Nov., 1939 (R.V.S.). Victoria: Otway Forest, one specimen, parasitic upon an anystid mite, on the foliage of a tree-fern, 16th Jan., 1937 (R.V.S.).

#### Biology.

At Glen Osmond the larvae occur as above; the adults occur from January to July, but are commonest from April to June; a very few adults have been taken in August and October.

Eggs taken under eucalypt bark at Glen Osmond on 23rd Feb., 1937, hatched out to a mixture of the larvae of *Erythraeus reginae* and *E. urrbrae* from 23rd Oct. to 6th Nov., 1937; other eggs from under eucalypt bark taken in Aug., 1937, hatched out to *E. urrbrae* larvae during Oct. and Nov., 1937.

Rearing experiments have been carried out with larvae taken parasitic on jassids and Psocoptera in the field. From these experiments a number of nymphs and two adults (one ♂ and one ♀) have been obtained (these adults, and the single adult of *E. reginae* obtained from a larva, are the first ever reared through from larvae in the family Erythraeidae, and have enabled the life-history of an erythraeid mite to be set out).

The life-history of *Erythraeus urrbrae* may be summarized as follows: the eggs are probably laid mainly in January and February, and hatch out to larvae over the following August to January; when fully-fed the larva leaves its host, and after remaining in an immobile state for 1–4 days, pupates; pupa I lasts 12–16 days, nymph 25–39 days, and pupa II 15–16 days. The adult lives for several weeks at least. The larva of *E. urrbrae* was previously known as *Bochartia longipes* Wom. 1934 (see introduction).

Details of the successful rearings are set out in Table 1 (all specimens were taken parasitic, on the hosts listed, at Glen Osmond, South Australia).

## ERYTHRAEUS WOMERSLEYI, n. sp. Fig. 20, A-H.

*Description of Larva (Type)*: Red. Body ovoid,  $350\mu$  long by  $305\mu$  wide. Dorsal scutum oval, flattened anteriorly,  $85\mu$  long by  $100\mu$  wide; with 2 pairs of slender almost simple sensillary setae with faint addressed ciliations, anterior  $47\mu$  long, posterior  $61\mu$ ;



Fig. 20.—*Erythraeus womersleyi*, n. sp. Larva. A, Dorsum; B, Venter; C, Dorsal scutum and eyes; D, Tarsus I; E, Tip of tarsus I; F, Capitulum from above; G, Same from below; H, Palpal tarsus. (All figures from type.)

TABLE I.

*Experimental Rearings of Stages of Erythraeus urbrae Wom., 1934, starting with Larvae.*

| Experiment No.  | Date Taken. | Left Host.                             | Became Dormant.      | Pupa I.  | Nymph Emerged.  | Nymph Immobile.                                 | Pupa II.  |
|---|-------------|--|----------------------|--|---|---|---|
| From foliage of <i>Eucalyptus rostrata</i> ; each larva parasitic on a jassid.                |             |  |                      |  |   |   |   |
| ACA 1 ..  | 7.xi.36     | 7.xi.36                                | —<br>(?)             | —<br>(less than 27)                                    | Before 4.xii.36<br>L, 605 $\mu$<br>ISD, 273 $\mu$                   | —   | —   |
| ACA 6A ..   | 7.xi.36     | 12.xi.36                               | —<br>(?)             | Probably 15.xi.36<br>(ca. 27)                          | 12.xii.36<br>L, 510 $\mu$<br>ISD, 187 $\mu$                         | —   | —   |
| ACA 19 ..   | 12.xii.36   | 13.xii.36                              | 15.xii.36<br>(2)†    | 17.xii.36<br>(13)                                      | 30.xii.36<br>L, 600 $\mu$ *<br>ISD, 308 $\mu$                       | —   | —   |
| From under bark of <i>Eucalyptus cladoclyx</i> ; each larva parasitic on <i>Myopsocus</i> sp. |             |  |                      |  |   |   |   |
| ACA 864 ..  | 16.xi.40    | 17.xi.40                               | 18.xi.40<br>(2)      | 20.xi.40<br>L, 830 $\mu$<br>W, 650 $\mu$<br>(15)       | 5.xii.40<br>(39)  | 13.i.41<br>L, 1,675 $\mu$<br>W, 1,080 $\mu$     | 14.i.41<br>L, 1,690 $\mu$ *<br>W, 1,120 $\mu$<br>(16)   |
| ACA 865 ..  | 16.xi.40    | Remained attached even after pupation. | Indefinite.<br>(?)   | 20.xi.40<br>L, 760 $\mu$<br>W, 595 $\mu$<br>(14)       | 4.xii.40<br>(11+)   | Nymph died<br>15.xii.40                         | —   |
| ACA 866   | 16.xi.40    | 20.xi.40                               | 21.xi.40<br>(4)      | 25.xi.40<br>L, 805 $\mu$<br>W, 640 $\mu$<br>(12)       | 7.xii.40<br>L, 705 $\mu$<br>W, 500 $\mu$<br>ISD, 334 $\mu$<br>(21+) | Nymph died<br>28.xii.40                         | —   |
| ACA 867 ..  | 16.xi.40    | 17-18.xi.40                            | 18.xi.40<br>(2)      | 20.xi.40<br>(—)  | Pupa killed with formalin.  | —   | —   |
| ACA 868 ..  | 16.xi.40    | 16-17.xi.40                            | 16-17.xi.40<br>(1-2) | 17-18.xi.40<br>L, 860 $\mu$<br>W, 730 $\mu$<br>(15-16) | 3.xii.40<br>(13+)   | Nymph died<br>16.xii.40                         | —   |
| ACA 869 ..  | 16.xi.40    | 16-17.xi.40                            | 16-17.xi.40<br>(1-2) | 17-18.xi.40<br>L, 845 $\mu$<br>W, 665 $\mu$<br>(14-15) | 2.xii.40<br>(—)   | Killed with alcohol<br>2.xii.40                 | —   |
| ACA 871 ..  | 16.xi.40    | 16-17.xi.40                            | 16-17.xi.40<br>(1-2) | 17-18.xi.40<br>L, 915 $\mu$<br>W, 715 $\mu$<br>(15-16) | 3.xii.40<br>(—)   | Killed with alcohol<br>3.xii.40                 | —   |
| ACA 874 ..  | 16.xi.40    | 16-17.xi.40                            | 17-18.xi.40<br>(1-2) | 19.xi.40<br>L, 795 $\mu$<br>W, 695 $\mu$<br>(16)       | 5.xii.40<br>(25)  | 28.xii.40<br>L, 1,590 $\mu$ *<br>W, 1,025 $\mu$ | 30.xii.40<br>L, 1,590 $\mu$ *<br>W, 1,090 $\mu$<br>(15) |
| ACA 877 ..  | 16.xi.40    | 16-18.xi.40                            | 20.xi.40<br>(1)      | 21.xi.40<br>L, 840 $\mu$<br>W, 680 $\mu$<br>(—)        | Pupa died.  | —   | —   |

\* Drawn or described (or both) in the text.

† Figures in brackets indicate the total time in days spent in that stage. Note.—The figures in the column for the nymphs are for the whole nymphal period, immobile period.

L, body length; W, body width; ISD, inter-sensillary distance (distance between centres of anterior and posterior sensillae).

with 3 pairs of non-sensillary setae (in the type specimen an extra seta occurs on the right side), stout, with very faint adpressed ciliations, and broadening at the end, which is toothed, anterior  $34\mu$  long, middle  $25\mu$ , posterior  $25\mu$ . Eyes 2+2. Dorsum with about 35 setae, stout, with adpressed ciliations; most taper distally, the tip having small teeth, a few posterior setae expanding slightly distally to a more strongly toothed tip; setae  $26-36\mu$  long, arranged approximately 2, 4, 3, 5, 5, 2, 4, 4, 2, 4. Venter: between coxae I 2 stout truncated setae with very faint adpressed ciliations and toothed at tip,  $26\mu$  long; between coxae II a similar pair  $20\mu$  long; between the levels of coxae II and III are 2 stout spiniform setae,  $16\mu$  long; behind coxae III are 4 rows each of 4 setae, parallel-sided and with truncated notched tips, stout or fairly stout, with very faint adpressed ciliations, setae  $22-34\mu$  long. Each coxa with one seta: on I strong, curved, spiniform,  $42\mu$  long; on II stout, blunt, slightly tapering,  $23\mu$  long; on III similar,  $24\mu$  long. Legs long and thin: I  $525\mu$  long, II  $500\mu$ , III  $625\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $97\mu$  long by  $20\mu$  high; none of its setae ciliated; empodium somewhat slender, falciform, over-reaching the claws, not ciliated; anterior claw straight or slightly retroflexed, with many strong ventral ciliations; posterior claw retroflexed, strongly ciliated ventrally. Metatarsus I  $131\mu$  long. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 8 setae respectively. Palpal claw with a strong dorsal tooth. Palpal tarsus as figured.

*Locality:* Glen Osmond, South Australia, one specimen (type), 26th Oct., 1938, parasitizing an adult *Erythroides serratus*, in débris at base of *Eucalyptus obliqua* (R.V.S.); type in author's collection.

Genus LEPTUS Latreille 1796.

*Préc. Car. Ins.*, 1796, 177.

*Genotype:* *Acarus phalangii* de Geer 1778.

LEPTUS ANOMALUS, n. sp. Fig. 21, A-H.

*Description of Larva (Type).* Fig. 21, A-H (21, F from another specimen): Red. Small. Body ovoid,  $175\mu$  long by  $145\mu$  wide. Dorsal scutum triangular, with rounded angles, anterior margin slightly concave, posterolateral margins slightly convex; scutum  $56\mu$  long by  $83\mu$  wide. Anterior part of shield thin, striated transversely, and carries the slender finely ciliated anterior sensillary setae  $33\mu$  long; posterior sensillary setae similar,  $66\mu$  long; 2 pairs of non-sensillary setae, as figured, to the shield, anterior pair slightly clavate, truncated, with many strong ciliations, posterior pair similar but parallel-sided,  $33\mu$  long. Eyes 1+1, near posterolateral borders of shield. Dorsum with about 88 stout slightly clavate truncated setae with many strong ciliations,  $22-35\mu$  long; the most anterior setae are one on each side, between the eye and the shield. Venter: between coxae I are 2 bushy setae, with many long ciliations,  $27\mu$  long; between coxae II 2 pairs of similar but more bushy setae, anterior pair  $20\mu$  long, posterior  $16\mu$ ; just behind coxae II 2 bushy setae,  $18\mu$  long; between coxae III 2 similar setae,  $20\mu$ ; then a curved row of 4, the medial 2 bushy,  $22\mu$  long, lateral 2 narrower,  $28\mu$  long; then a row of 6 setae, the lateral 2 similar to the lateral 2 of the previous row,  $26\mu$  long, medial 4 bushy, elongate-oval,  $23\mu$ ; then 13 setae in 2 rows: 6, 7, elongate, expanding slightly distally, strongly ciliated,  $26-27\mu$  long. Each coxa with one seta: on I long, strongly ciliated, slightly tapering,  $45\mu$  long; on II short,  $18\mu$ , blunt, bushy, with fairly long ciliations; on III blunt, strongly ciliated,  $22\mu$  long. Legs long and thin: I  $530\mu$  long, II  $430\mu$ , III  $530\mu$  (including coxae and claws). Each trochanter with one seta. Tarsus I  $95\mu$  long by  $26\mu$  high; empodium fairly strong, falciform, simple, over-reaching the claws; anterior claw strong, falciform, with a few faint ridges along its sides; posterior claw strong, sinuously curved, with a number of long strong ventral ciliations and 2 strong dorsal ciliations; all tarsal setae ciliated, except for a curved tapering rod that arises two-thirds along the dorsum of the tarsus. Metatarsus I  $125\mu$  long. Capitulum as figured, dorsally flask-shaped with a concave posterior margin. Palpal femur, genu, tibia, tarsus with 1, 2, 3, 8 setae respectively. Palpal claw strong and simple (no accessory teeth). Palpal tarsus as figured.

*Locality:* Glen Osmond, South Australia, 28 specimens, between Sept. and Nov., 1937 (R.V.S.)—see under *Erythroides claratus*, n. sp. (larval), biology (1) (p. 16), for the

origin of these. One specimen taken as type; from this the descriptions and figures have been taken, except Fig. 21, F. The mandibles of the type specimen are distorted by compression. All specimens in author's collection.

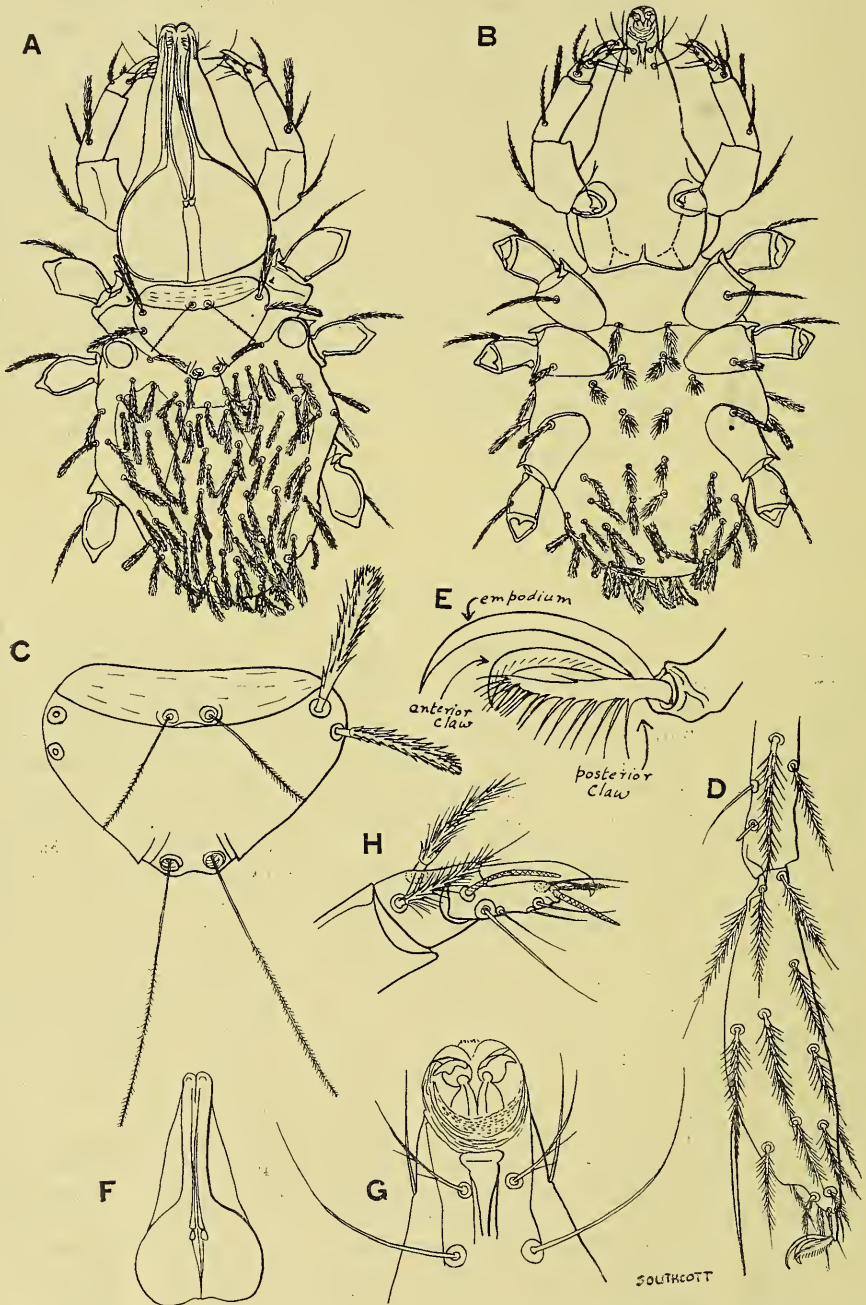


Fig. 21.—*Leptus anomalus*, n. sp. Larva. A, Dorsum (capitulum distorted); B, Venter; C, Dorsal scutum; D, Tarsus I; E, Tip of tarsus I; F, Capitulum from above, undamaged specimen; G, Mouth-parts from below. (All figures except F, from type.)

*Remarks:* The approximation of the coxae shown in the figures is of no taxonomic significance, indicating merely that the specimens were unfed. I have seen similar approximations in unfed larvae of *Erythraeus reginae* and *E. urbrae*.

The systematic position of this species will be dealt with in a subsequent paper by Womersley.

Genus *CALLIDOSOMA* Womersley 1936.

*J. Linn. Soc. Lond., Zool., 40(269): 120.*

*Genotype: Caeculisoma ripicola* Womersley 1934 (adult).

*Generic Definition of Larva:* Eyes one on each side. Dorsal scutum squarish, with rounded angles, concave anteriorly; with 2 pairs of sensillary setae and 3 pairs of non-sensillary setae. Anterior sensillae at one-fourth the length of the shield back from the anterior margin; posterior sensillae on posterior margin of scutum. Anterior non-sensillary setae arise at anterolateral angles of scutum. Venter: 2 setae between coxae I, 2 between coxae II, 2 more between or just anterior to coxae III. Coxa I with one seta, coxae II and III each with 2 setae. Legs of 6 segments: coxa, trochanter, femur (with a pseudo-articulation), tibia, metatarsus, tarsus. Tarsus with a strong falciform empodium, over-reaching the 2 claws; anterior claw strong, falciform, simple; posterior claw pulvilliform, ciliated ventrally, and with a strong terminal hook. Palpal coxa, femur, genu, tibia, tarsus with 0, 1, 1, 3, 7 setae respectively; tibial claw strong, bifurcate. Mandibles rounded. Capitulum ventrally with 2 pairs of hypostomal setae.

*Remarks:* This definition is based on the larva of *Callidosoma womersleyi*, n. sp., only. Had not this larva been bred to a nymph, it would have been necessary to have provisionally included it in the larval genus *Erythraeus* Oudemans 1912 (non *Erythraeus* Latreille 1806).

*CALLIDOSOMA WOMERSLEYI*, n. sp. Figs. 22, A-K; 23, A-M.

*Description of Adult (Type).* Fig. 22, A-E: Red. Body ovoid, 830 $\mu$  long by 660 $\mu$  wide. Crista linear, continued beyond posterior sensillary area. Anterior end of crista bulbous. Distance between centres of anterior and posterior sensillae 243 $\mu$ . Sensillary setae to crista filiform, with a few ciliations, anterior 43 $\mu$  long, posterior 49 $\mu$ . Anterior sensillary area also carries 5 stout setae to 64 $\mu$  long, with broad pointed scales. Dorsal setae parallel-sided or slightly clavate, with the same broad, flattened, pointed scales, setae 32-58 $\mu$  long. Ventral setae fine, tapering, ciliated, 32-34 $\mu$  long. Palp as figured, claw ventrally with a broad blunt basal tooth. Legs stout: I 1280 $\mu$  long, II 860 $\mu$ , III 980 $\mu$ , IV 1280 $\mu$  (including coxae and claws). Tarsus I 180 $\mu$  long by 70 $\mu$  high. Metatarsus I 220 $\mu$  long. All metatarsi with the normal protuberances (smaller similar structures are present dorsally at the distal ends of the femora and tibiae).

*Description of Larva.* Fig. 23, A-M: Red. Body oval, 370 $\mu$  long by 240 $\mu$  wide. Dorsal scutum squarish, with convex sides and rounded angles, except for the slightly concave anterior margin; length 73 $\mu$ , width 83 $\mu$ . Shield with 2 pairs of sensillary setae, filiform, slightly ciliated, anterior 27 $\mu$  long, posterior 25 $\mu$ ; with 3 pairs of strong blunted ciliated non-sensillary setae, anterior 26 $\mu$  long, middle 25 $\mu$ , posterior 22 $\mu$ . Eyes 1+1, posterior and lateral to the shield. Dorsal setae fairly stout, with scales as figured, 21-36 $\mu$  long. Ventral setae almost spiniform with little ciliation, one pair between each pair of coxae. Behind coxae III setae arranged in rows of 4. Coxal setae: on I pointed, very slightly ciliated, 21 $\mu$  long; on II similar, 20 $\mu$ ; on III similar, 20 $\mu$ . Legs: I 510 $\mu$  long, II 505 $\mu$ , III 600 $\mu$  (including coxae and claws). Tarsal setae ciliated except for a long spiniform dorsal rod; empodium long, fairly strong, falciform, simple, over-reaching the 2 claws; anterior claw strong, falciform, simple; posterior claw pulvilliform, with a strong terminal claw. Capitulum as figured. Palpal femur, genu, tibia, tarsus with 1, 1, 3, 7 setae respectively. Palpal claw bifurcate.

*Description of Post-Larval Pupa (Pupa I).* Fig. 22, F: Red. Ovoid, flattened ventrally. Length 0.7 mm.; width 0.5 mm. Heavily setose; setae lanceolate, simple, to 105 $\mu$  long.

*Description of Nymph.* Fig. 22, G-K: Red. Body oval, 690 $\mu$  long by 475 $\mu$  wide. Crista and eyes as in adult, except that the anterior bulb of the crista carries only 2-3 non-

sensillary setae. Anterior sensillary setae  $45\mu$  long, posterior  $47\mu$ . Dorsal setae similar to adult, but weaker,  $30-50\mu$  long. Palp as figured; palpal claw ventrally with a broad blunt basal tooth. Legs: I  $1110\mu$  long, II  $810\mu$ , III  $890\mu$ , IV  $1180\mu$  (all including coxae and claws). Protuberances on legs as in adult. Tarsus I  $159\mu$  long by  $68\mu$  high. Metatarsus I  $192\mu$  long.

*Locality:* Glen Osmond, South Australia. Type adult (ACA 31) obtained by sweeping foliage of *Eucalyptus rostrata*, 19th Dec., 1936 (R.V.S.).

Larvae have been taken in fair numbers, attached to jassids, by sweeping the foliage of *Eucalyptus rostrata*, during December-February (mostly December) at Glen Osmond

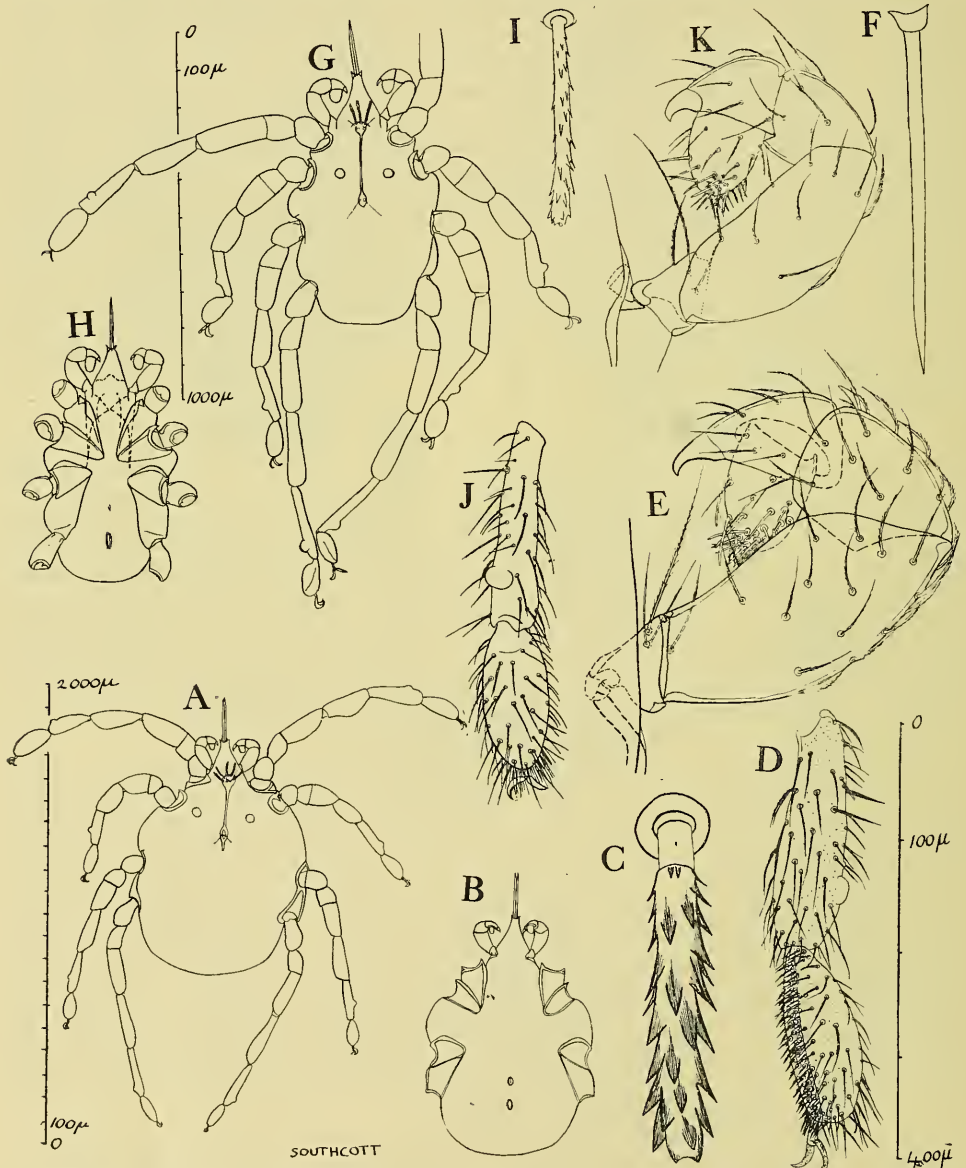


Fig. 22.—*Callidosoma womersleyi*, n. sp. A-D, Adult (type): A, Dorsal, outline; B, Venter, outline, to same scale; C, Dorsal seta; D, Tarsus I and metatarsus I; E, Palp; F, Pupa I, seta; G-K, Nymph; G, Dorsal, outline; H, Venter, to same scale; I, Dorsal seta; J, Tarsus I and metatarsus I; K, Palp. (I and C are to different scales.)



(1936-1939; R.V.S.). The larvae are attached to the abdomens of the jassids, underneath the wings (*not* on exposed parts; contrast *Erythraeus* spp. larvae). Frequently 2 or 3 larvae are on the one host.

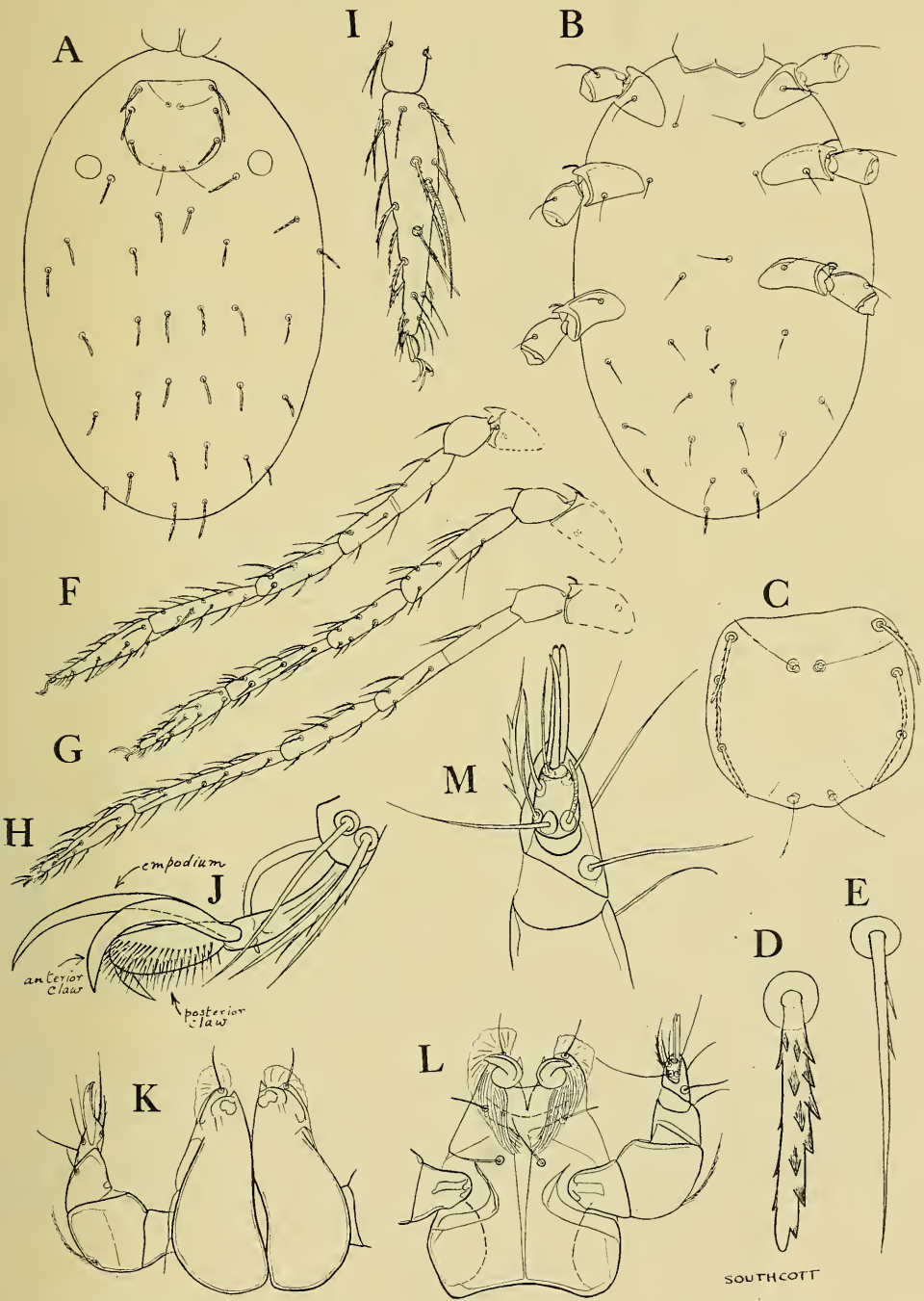


Fig. 23.—*Callidosoma womersleyi*, n. sp. Larva. A, Dorsum; B, Venter; C, Dorsal seutum; D, Dorsal seta; E, Ventral seta; F, G, H, Legs I, II, III (from above); I, Tarsus I; J, Tip of tarsus I; K, Capitulum from above, slightly distorted; L, Capitulum from below.

*Biology.*

Three specimens have been reared from larvae to nymphs, which have been correlated, on morphological grounds, with the adult obtained in the same locality. Relevant details are set out below:

| Specimen.                | ACA 24.   | ACA 75.   | ACA 140.   |
|--------------------------|-----------|-----------|------------|
| Larva detached from host | 14.xii.36 | 25.xii.36 | 8.i.37     |
| Became immobile .. ..    | 15.xii.36 | 27.xii.36 | 11.i.37    |
| Ecdysis to Pupa I .. ..  | 19.xii.36 | 29.xii.36 | —          |
| Nymph emerged .. ..      | 28.xii.36 | 10.i.37   | 23–27.i.37 |

Thus the pupa I stage lasts 9–12 days.

Genus *MICROSMARIS* Hirst 1926.

*Ann. Mag. nat. Hist.*, (9) 18(108): 613.

*Belaustium* Womersley 1934 (as larva), *Rec. S. Aust. Mus.*, 5(2): 250.

[non] *Balaustium* von Heyden 1826 (adult), *Vers. syst. Einth.* in *Isis*, 20: 609. (See Oudemans, 1937, *Krit. Hist. Overz. d. Ac.*, III D, p. 1932.

*Genotype*: *Microsmaris mirandus* Hirst. *Ibid.*, p. 613.

*MICROSMARIS* sp. Fig. 24, A–E.

In 1934 Womersley described *Belaustium cristatum* (l.c., p. 251) from Glen Osmond, South Australia, as a common larval species there. It was allotted to *Belaustium* (*sic*) following Oudemans (1912). Similar or identical larvae have been taken at Glen Osmond by the author, from 1936 to 1940. They are found in vast numbers in the summer, running up trunks of eucalypts, and among the surrounding vegetation. As their numbers decrease in November and December the numbers of small nymphs of *Microsmaris* increase rapidly. These nymphs are identical in coloration with the larvae, and to the naked eye the mode of progression of the two is almost indistinguishable; in fact it needs close attention to distinguish them macroscopically in the field. On account of these details the author believed, as early as 1936, that these larvae belonged to the adult genus *Microsmaris*. Many attempts at rearing these larvae were made, small insects and water being provided, from 1936 onward. None of these was successful, nor was any larva ever taken by the author attached to an insect in the field. It was not until 1940 that the author was able to prove the relation between them. This was achieved by selecting in the field a number of the largest larvae available, and then confining them to tubes. Small insects were given, but these were not utilized; water and a piece of grass were also added to the tubes. From these experiments one larva (ACA 882B) from Glen Osmond was reared to a nymph. It became immobile on 19th Nov., 1940, pupated on 25th Nov., 1940, and a *Microsmaris* nymph emerged on 4th Dec., 1940, i.e., a first pupal instar of 9 days. This pupa is figured in Fig. 24, B–E.

At present it has not been possible to revise the taxonomy of the genus *Microsmaris*. It is worthy of remark that *Microsmaris goannae* Hirst 1928 (adult) was originally described from a neighbouring locality as a common species. Womersley's larva is here provisionally renamed *Microsmaris cristatus*. It is quite possible that Oudemans' larval "*Belaustium*" does really belong to the adult genus *Balaustium*. Whereas *Balaustium* is a world-wide genus, so far *Microsmaris* has been recorded from only Australia and New Zealand. *Balaustium* (adult) and *Microsmaris* (adult) appear to be fairly closely related. Adult specimens of *Microsmaris* from the same situation have laid small red eggs in captivity, but so far none of these has hatched.

## SUMMARY.

Experimental rearings of several genera and a number of species of Australian Erythraeidae have been accomplished, thus enabling a number of mistakes in the correlation of adult and larval genera to be rectified. The only Australian larvae of

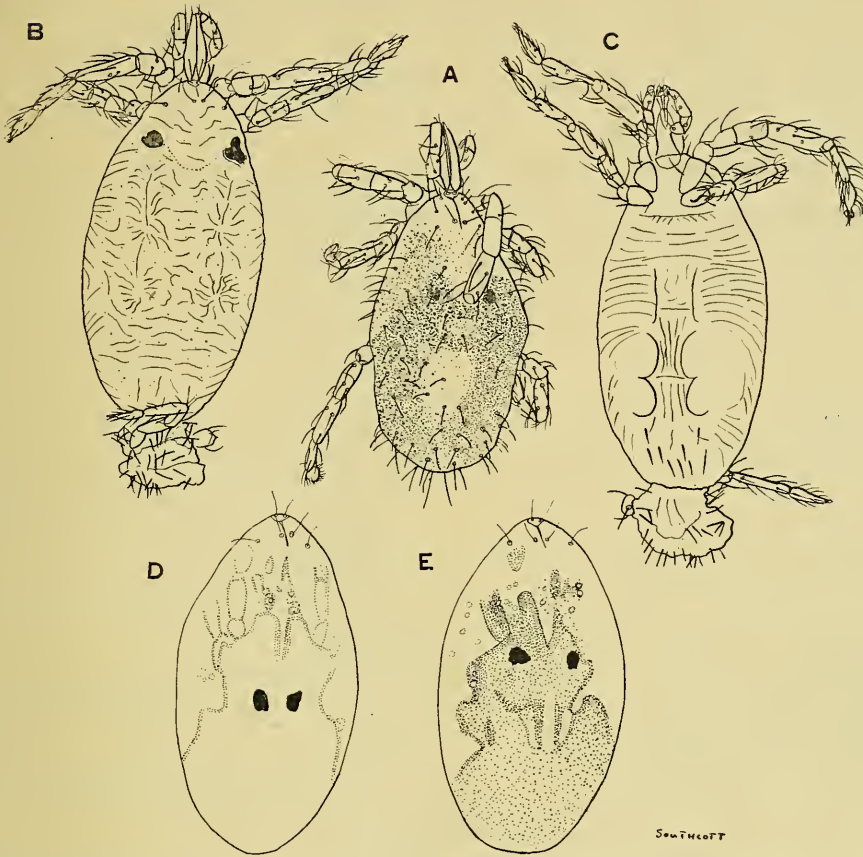


Fig. 24.—*Microsmaris* sp. A, Larva, fully-fed and immobile, prior to ecdysis, by transmitted light; B, Pupa I, with cast larval skin still attached, dorsal aspect (ACA 882B); C, Same from below; D, Same, showing outline of developing nymph, on 28.xi.40; E, Same on 1.xii.40.

Erythraeidae that were previously correctly generically correlated with adults belong to the genus *Leptus* Latreille 1796. *Erythraeus* larval is a heterogeneous group with no relationship to the adult genus *Erythraeus* Latr. 1806. The larva of *Callidosoma* Womersley 1936 is described; but for the successful rearing of larvae to nymphs, it would have been necessary provisionally to include the larva of this species in *Erythraeus* larval. The larval genus *Bochartia* Oudemans 1910 has been proven to be the larva of *Erythraeus* Latr. 1806 by the successful rearings of a number of species. Womersley's larval *Belaustium cristatum* has been proven to belong to the adult genus *Microsmaris* Hirst 1926.

Two species of erythraeid mites have been successfully reared through every stage of their life-histories, thus enabling the life-history of the Erythraeidae to be defined: egg (5–11 months), larva (1–3 weeks), pupa I (9–16 days), nymph (21–39 days), pupa II (15–16 days), adult (several weeks and longer). The cycle occurs annually, the major portion of the life-history being passed as the egg. No such rearing has previously been accomplished in this family.

The taxonomy of part of the Australian Erythraeidae has been revised, 3 new genera being erected: *Erythroides*, n. gen. for *Erythraeus serratus* Womersley 1936, and 3 new species described, also a larva proven to belong to this genus by an experimental rearing, and thus enabling the larval characters for the genus to be defined; *Erythrellus*, n. gen. and *Parerythraeus*, n. gen. for entirely new forms.

The taxonomic revision covered in this paper is set out thus:

| Adult.  | Larva, etc.  |
|---|--|
| <i>Erythrellus imbricatus</i> , n. gen., n. sp. | Not known.   |
| <i>Parerythraeus gregoryi</i> , n. gen., n. sp. | Not known.   |
| <i>Erythroides</i> , n. gen.                    | Larva defined; previously unknown.   |
| <i>Erythroides serratus</i> .                   | ?  |
| = <i>Erythraeus serratus</i> Wom. 1936.         |  |
| <i>Erythroides neoserratus</i> , n. sp.         | ?  |
| ?   | <i>Erythroides clavatus</i> , n. sp.   |
| <i>Erythroides darwini</i> , n. sp.             | Not known.   |
| <i>Erythroides macdonnelli</i> , n. sp.         | Not known.   |
| <i>Erythraeus</i> Latr. 1806.                   | <i>Bochartia</i> Ouds. 1910.   |
| <i>E. celeripes</i> (Rainbow 1906).             | Not known.   |
| <i>E. imperator</i> (Hirst 1928).               | Probably <i>E. oudemansi</i>   |
|   | = <i>Bochartia oudemansi</i> Wom. 1936.  |
| <i>E. reginae</i> (Hirst 1928).                 | Larva previously unknown; described; also every other stage in the life-history.   |
| <i>E. antepodanus</i> (Hirst 1928).             | Not known.   |
| Not known.                                      | <i>E. stuarti</i> , n. sp.   |
| <i>E. guttatus</i> , n. sp.                     | Probably <i>E. osmondensis</i> , n. sp.  |
| <i>E. pilosus</i> (Hirst 1928).                 | Larva and pupa I and nymph described; previously unknown.  |
| <i>E. urbrae</i> Wom. 1934.                     | Every stage in life-history reared, described. Larva previously described as <i>Bochartia</i> ? <i>longipes</i> Wom. 1934. |
| Not known.                                      | <i>E. womersleyi</i> , n. sp.  |
| <i>Leptus</i> Latr. 1796.                       | Previously correctly correlated. Confirmed by the rearing of a larva to a nymph (not described in text).                   |
| Not known.                                      | <i>Leptus anomalus</i> , n. sp.  |
| <i>Callidosoma</i> Wom. 1936.                   | Larva established; previously unknown.   |
| <i>C. womersleyi</i> , n. sp.                   | Larva, pupa I, nymph described; previously unknown.  |
| <i>Microsmaris</i> Hirst 1926.                  | See below.   |
| Possibly <i>M. goannae</i> Hirst 1928.          | Larva <i>Belaustium cristatum</i> Wom. 1934 proven as <i>Microsmaris</i> ; pupa I figured.                                 |

#### ACKNOWLEDGEMENTS.

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